

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
11 January 2001 (11.01.2001)

PCT

(10) International Publication Number  
**WO 01/02673 A1**

(51) International Patent Classification<sup>7</sup>: E04G 11/06,  
17/06

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(21) International Application Number: PCT/US00/18137

(22) International Filing Date: 30 June 2000 (30.06.2000)

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(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/142,160 1 July 1999 (01.07.1999) US

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE,  
DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU,  
ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS,  
LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ,  
PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT,  
TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

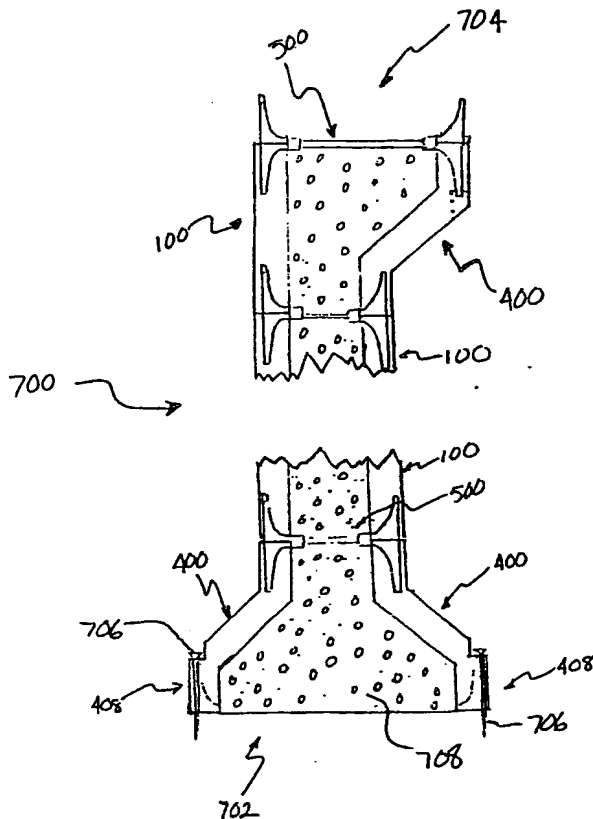
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(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian  
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: WALL STRUCTURE



(57) Abstract: A wall panel (100) is adapted to interlock with another vertically offset panel and is adapted for connection with a tie to another laterally offset panel. A substantially H-shaped tie assembly (200 or 500) is adapted to connect two wall panels together. A corner assembly (810) is for connecting a first outer wall to a second outer wall and a first inner wall to a second inner wall. The corner assembly includes an outer corner member (812) adapted to be connected to an inner corner member (814).

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patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

— Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

**Published:**

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

## WALL STRUCTURE

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### RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 60/142,160, filed July 1, 1999.

### TECHNICAL FIELD

This invention relates generally to wall structures, and more particularly to wall structures having tie assemblies incorporated therein.

### BACKGROUND OF THE INVENTION

5 Panels of polystyrene and other materials are often used as forms for poured concrete walls. After the concrete has hardened, the polystyrene panels may either be left in place or stripped away to expose the concrete wall. A continual need exists for relatively inexpensive forms that reduce costs, simplify installation, and increase the strength of the wall form as well as provide other advantages during construction and later use.

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### SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to address and obviate problems and shortcomings of previously available wall structures.

To achieve the foregoing and other objects and in accordance with the present invention, a wall panel is provided that is adapted to interlock with another vertically offset panel and adapted for connection with a tie to another laterally offset panel. The wall panel is provided with an upper end including an upper edge and an upper tongue extending from the upper edge and an upper groove defined in the upper end. An upper tie channel is defined in the upper end and adapted to receive a portion of a tie.

To further achieve the foregoing and other objects and in accordance with the present invention, a substantially H-shaped tie assembly is provided that is adapted to connect two wall panels together. The tie assembly is provided with a first handle including a first elongated anchor and a first connecting member attached to the first elongated anchor. A second handle is further provided that includes a second elongated anchor and a second connecting member attached to the second elongated anchor. The tie assembly also comprises a link having a first end connected to the first connecting member and a second end connected to the second connecting member.

To still further achieve the foregoing and other objects and in accordance with the present invention, a corner assembly is provided for connecting a first outer wall to a second outer wall and a first inner wall to a second inner wall. The corner assembly includes an outer corner member including an upper end with an upper edge, the upper end of the outer corner member defines an upper channel. The outer corner member is adapted to connect a first outer wall to a second outer wall. The corner assembly further comprises an inner corner member including an upper end with an upper edge, the upper

end of the inner corner member defines an upper channel. The inner corner member is adapted to connect a first inner wall to a second inner wall.

Still other embodiments, structural combinations, advantages and objects of the present invention will become apparent to those skilled in the art from the following description wherein there are shown and described alternative exemplary embodiments of this invention for illustration purposes. As will be realized, the invention is capable of other different, obvious aspects, objects and embodiments, all without departing from the scope of the invention. Accordingly, the drawings, objects and descriptions should be regarded as illustrative and exemplary in nature only, and not as restrictive.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed the same will be better understood from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a front elevational view of an exemplary embodiment of a wall panel in accordance with the present invention;

FIG. 2 is a top plan view of the wall panel of FIG. 1;

FIG. 3 is a cross sectional view of the wall panel along line 3-3 of FIG. 1;

FIG. 4 is a side elevational view of the wall panel of FIG. 1;

FIG. 5 is a partial enlarged view of an upper tie channel of FIG. 2;

FIG. 6 is a partial cross sectional view of the wall panel along line 6-6 of FIG. 1;

FIG. 7 is a perspective view of the wall panel of FIG. 1;

FIG. 8 is a perspective view of another exemplary embodiment of a wall panel;

FIG. 9 is a front elevational view of the wall panel of FIG. 8;

FIG. 10 is a top plan view of the wall panel of FIG. 8;

FIG. 11 is a side elevational view of the wall panel of FIG. 8;

FIG. 12 is a side elevational view of a half portion of one exemplary embodiment  
5 of a tie assembly;

FIG. 13 is an end elevational view of the half portion of FIG. 12;

FIG. 14 is a partial sectional view of the half portion along line 14-14 of FIG. 12;

FIG. 15 is an exploded perspective view of two half portions before assembly;

FIG. 16 is an assembled view of an assembled tie assembly in accordance to one  
10 exemplary embodiment of the present invention;

FIG. 17 is a partial cross sectional view of a wall structure wherein the tie  
assembly is adjusted to a relatively minimized position;

FIG. 18 is another partial cross sectional view of a wall structure wherein the tie  
assembly is adjusted such that the wall panels are spaced farther apart;

15 FIG. 19 is yet another partial cross sectional view of a wall structure wherein the  
tie assembly is adjusted to a relatively maximized position;

FIG. 20 is an elevational perspective view of one exemplary embodiment of a wall  
structure in accordance to the present invention;

FIG. 21 is an elevational view of a corner member in accordance to one exemplary  
20 embodiment of the invention;

FIG. 22 is a top plan view of a corner member of FIG. 21;

FIG. 23 is a perspective view of the corner member of FIG. 21;

FIG. 24 is a perspective view of a corner assembly in accordance to one exemplary  
embodiment of the present invention;

FIG. 25 is an exploded view of another tie assembly in accordance to another exemplary embodiment of the present invention;

FIG. 26 is a partial sectional view along line 26-26 of FIG. 25;

FIG. 27 is a sectional view along line 27-27 of FIG. 25;

5 FIG. 28 is a partial sectional exploded view of the tie assembly of FIG. 25;

FIG. 29 is a partial sectional view of an assembled tie assembly of FIG. 25;

FIG. 30 is a front end elevational view of the handle of the tie assembly of FIG. 25;

10 FIG. 31 is a back end elevational view of the handle of the tie assembly of FIG. 25;

FIG. 32 is a perspective exploded view of the tie assembly of FIG. 25;

FIG. 33 is an assembled perspective view of the tie assembly of FIG. 25;

FIG. 34 is a perspective view of another corner member in accordance to another exemplary embodiment of the present invention;

15 FIG. 35 is a front elevational view of the corner member of FIG. 34;

FIG. 36 is a top plan view of the corner member of FIG. 34;

FIG. 37 is another corner assembly in accordance to another exemplary embodiment of the present invention; and

20 FIG. 38 is a wall structure in accordance to one exemplary embodiment of the present invention.

### **DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS**

Turning now to the drawings, wherein like numbers indicate the same or corresponding elements throughout the views, FIGS. 1-7 depict a wall panel 100 constructed in accordance with the principles of the present invention. The wall panel 100 may be fabricated in a uniform manner such that a plurality of identical wall panels 100 may be connected together to build a wall structure. For instance, as shown in FIG. 20, a plurality of wall panels 600 may be linked together to build a wall structure 602.

The wall panels of the present invention may be formed from many different materials or combinations of materials to accommodate the particular application of use. For instance, the wall panels may be formed from one or more plastics, metals, fiberglass or other composite materials. In one particular embodiment, the panels may be shape molded from expanded polystyrene such as two pound density foam. In such an embodiment pre-expanded polystyrene beads may be introduced in a mold assembly. A heat source, such as high-temperature steam may be administered to further expand the beads and thereafter fuse the beads together to form the shape of the wall panel. After cooling, the shaped wall panel may be removed from the mold.

Each wall panel of the present invention is formed with unique features which simplify assembly while simultaneously increasing the structural integrity of the wall structure. In one embodiment, as shown in FIG. 1, the wall panel 100 may include an upper end 104 including an upper edge 106 and a lower end 108 including a lower edge 110. Each wall panel 100 may further include a first side portion 112 including a first edge 114 and a second side portion 116 including a second side edge 118. While the figures of the present invention illustrate a planar, rectangular wall panel 100, it is understood that other panel shapes may be provided such as triangular, square or other



polygonal shapes and may be formed with substantially flat planer portions and/or a non-planer portions according to the desired wall characteristics and/or wall shape requirements.

As shown in FIG. 1 the wall panel 100 may further include structure for  
5 interconnecting the wall panel 100 with another wall panel of similar or identical features. For example, as shown in FIG. 1, an upper tongue 120 extends from the upper edge 106. The upper tongue 120 is adapted to be received by a groove defined in another vertically-offset wall panel. Tongues and grooves throughout this application further align adjacent wall structure components to form a substantially continuous wall. The wall panel 100  
10 may further include an upper groove 122 defined in the upper end 104 of the wall panel 100. As also shown in FIG. 1, a lower tongue 124 extends from a lower edge 110 of the wall panel 100 and is adapted to be received in the corresponding groove defined in another vertically-offset wall panel. The wall panel 100 may also include a lower groove 126 defined by the lower end 108 of the wall panel 100 adapted to receive a  
15 corresponding tongue defined in another vertically-offset wall panel.

It is understood that the wall panel 100 may comprise a single tongue. For example, a single upper tongue 120 extending at least partially along or substantially along the entire length of the upper edge 106 of the wall panel 100. Similarly, the lower groove 126 may be defined by the lower end 108 of the wall panel 100 and extend at least  
20 partially or substantially along the entire length of the lower end 108 of the wall panel 100. Alternatively, as best shown in FIG.1, the upper end 104 of the wall panel 100 may be provided with both tongue and groove portions while the lower end 108 of the wall panel 100 also includes corresponding offset groove and tongue portions. Providing both tongue and groove portions on each of the upper and lower ends of the panel helps

prevent lateral shifting of the wall panel 100 relative to another vertically-offset wall panel.

While FIG. 1 depicts two upper tongue and groove portions and two lower tongue and groove portions, it is understood that any number of tongue and groove portions may be provided depending on the size of the wall panel 100 and the particular application of the panel. Moreover, the spacing between the tongues and grooves may be 12 inches for instance wherein a tongue and groove combination will exist every 24 inches.

As depicted in FIG. 1, the wall panel 100 may be provided with one or more upper tie channels 128 defined in the upper end 104 of the wall panel 100. Similarly, the wall panel 100 may be provided with one or more lower tie channels 130 defined in the lower end 108 of the wall panel 100. In one embodiment, and as shown in FIG. 1, tie channels 128, 130 are arranged as pairs of upper tie channels 128 and lower tie channels 130. Each pair of tie channels are offset horizontally from one another along the length of the wall panel 100. The pairs of tie channels may be offset any distance. For instance the tie channel pair may be offset 8 inches from one another.

An indicator may be provided to facilitate location of the tie channel pairs while viewing an outer surface 134 of the wall panel 100. For instance, a bead 132 may be formed on the outer surface 134 of the wall panel 100 as best shown on FIG. 1. Other indicators may also be used including but not limited to grooves, discolorations, markings, or other indicia.

Upper notches 138 are defined in the upper end 104 of the wall panel 100 for reception of a portion of a tie assembly as described more fully below. The notches 138 may extend from the inner surface 136 to a corresponding upper tie channel 128. Similarly, one or more lower notches 140 may extend from the inner surface 136 of the wall panel 100 to a corresponding lower tie channel 130. Certain upper notches 138 may

be further defined by one or more upper tongue(s) 120 and similarly the lower notches 140 may be defined by one more lower tongue(s) 124. Alternatively, or in addition, shown in FIG. 1, certain upper notches 138 may extend from the inner surface 136 of the wall panel 100 to an upper groove 122. Alternatively, or in addition, the lower notches 140 may also extend from the inner surface 136 to the lower groove 126.

The upper groove 122 may be defined by the upper end 104 such that the upper groove 122 communicates with one or more upper tie channels 128. Similarly, the lower groove 126 may be defined by the lower end 108 of the wall panel 100 such that it communicates with one or more lower tie channels 130.

The first side portion 112 and the second side portion 116 may also include inter-engaging portions for abutting against corresponding portions of additional side panels laterally adjacent to the side panel 100. For instance, the first side portion 112 may define one or more side groove(s) 142 and the second side edge 118 may be provided with one or more side tongue(s) 144 extending therefore. The side tongue 144 is adapted to be received in a corresponding groove formed in a side portion of an adjacent wall panel.

As shown in FIG. 20, the side portions 612 and 616 may be formed with a stepped edge with one or more stepped portion(s) and may be further defined wherein each edge comprises one or more tongues and grooves. For instance, as shown in FIG. 20, the first side edge 612 may include a lower outwardly extending step portion 613 with an adjacent area defined by another side portion 615 designed to abut another wall panel 600. The side edges 612, 616 may be formed with both a tongue and a groove in a stepped manner in order to discourage vertical relative movement between adjacent wall panels and to precisely position one wall panel 600 relative to another side panel 600 when assembling the wall structure 602.

FIGS. 8-11 depict another embodiment of a wall panel 400 constructed according to the principles of the present invention. The wall panel 400 is substantially identical to the wall panel 100 previously described and depicted in FIGS. 1-7 except that the wall panel 400, include planar portions that extend along different planes. As best illustrated in FIGS. 8 and 11, for example, an upper end 404 is offset relative to a lower end 408 and includes an intermediate portion 409 extending between the upper end 404 and the lower end 408. In one particular embodiment, as shown in phantom lines in FIG. 8, the upper end 404 extends along a first plane 411, while the lower end 408 extends along a second plane 413 and the intermediate portion 409 extends along a third plane 415. In one embodiment the first plane 411 and the second plane 413 are substantially parallel to one another while the third plane 415 extends at an angle relative to each of the first plane 411 and the second plane 413.

As shown in FIG. 8, an insert block 417 may be associated with each tie channel. As shown in FIG. 38, the insert blocks 417 may be removed to allow a spike, stake, or other anchoring mechanism to mount the wall structure securely to a ground surface during installation. Once an insert block 417 is removed, the corresponding tie channel becomes a through channel wherein the stake may extend through openings in each side of the channel to permit a stake to be inserted therethrough as shown in FIG. 38.

It will be appreciated that the embodiment of the wall panel 400 as shown in FIGS. 8-11 may be advantageous in that a plurality of wall panels 400 may be used in combination to provide a flared end wherein a double wall using the wall panels 400 of the embodiment as shown in FIG. 14 will provide one end with a large cross-sectional area than the other end. As shown in FIG. 38, a wall structure 700 is formed with the wall panels 100 and 400 described above. For instance, two wall panels 400 may be used in

combination such that the lower ends 408 of the wall panels 400 extend outwardly to form a footer or anchor foundation 702.

As illustrated in FIG. 38, one or more of the wall panels 400 may be inverted to provide the wall structure 700 with a flared upper end 704 that may be useful in wall constructions. In addition, two wall panels 400 may be offset relative to one another to merely change the direction of the wall. Wherein the cross-sectional space at each end is substantially identical.

FIGS. 12-19 depict a tie assembly 200 in accordance with one embodiment of the present invention. FIG. 12 illustrates a top view of one half 201 of the tie assembly 200 prior to installation. Two identical halves 201 are connected together to form the tie assembly 200 as described more fully below.

The tie half 201 includes a handle 202 comprising an elongated anchor 204 that may be formed in the shape of an elongated tongue member as shown in FIG. 12 for example. The handle 202 further comprises a connecting member 206 attached adjacent to the elongated anchor 204. On or more reinforcing ribs 208 may extend between the anchor 204 and the connecting member 206 to provide rigidity.

As best shown in FIG. 14, the connecting member 206 may be formed as a cage having ribs 212 and slots 210 defined between adjacent ribs 212. The lower portions of the locking ribs 212 are provided with an angled surface 214 that will be described more fully below. Additional ribs 213 are formed on the lower portion and define additional slots 222 between adjacent ribs 213. As shown in FIG. 12, the connecting member 206 may be formed with a first side 218 and a second side 220. The sides extend along the connecting member 206 and connect together the locking ribs 212 and the additional ribs 213. As shown in FIG. 14, the first side 218 (not shown in FIG. 14), the second side 220

together with the ribs 212, 213 define an insert channel 216 that extends through the connecting member 216 and communicates with a slot 205 (best illustrated in FIG. 13) formed in the elongated anchor 204. As further illustrated in FIG. 12 an elongated half 226 of the link 224 extends from an end portion of the connecting member 206. The elongated half 226 of the link 224 includes a first side 228 as shown in FIG. 6 and a second side 230. A plurality of locking teeth 232 extend downwardly from a lower portion of the elongated half 226 of the link 224.

FIG. 15 depicts an exploded view of a tie assembly 200. During assembly, two identical half portions 201 of the tie assembly 200 are inverted relative to one another such that one end of the elongated half 226 of one of the half portions 201 may be inserted into the channel 216 of the connecting member 206 of the other half portion 201. In a similar manner, an end portion of the elongated half 226 of the other half portion 201 is simultaneously inserted into the channel 216 of the connection member 206 of the first half portion 201 to form the assembled tie assembly 200 as shown in FIG. 16.

FIGS. 17-19 illustrate the tie assembly 200 adjusted at different lengths to control the distance between opposing wall portions 100. For example, after initial assembly, the tie assembly 200 will be at a maximum adjustment such that the wall panels may be oriented at a predetermined position. The handles 202 may moved closer together, causing each half portion 201 to extend further through the corresponding insert channel 216 until the end of the elongated half 226 extends through the slot 205 defined by the elongated anchor 204. The handles may be further moved together for orienting the wall panels 100 at a minimum distance relative to one another.

The unique features of the tie assembly 200 and the wall panels 100 and 400 enable quick assembly to fabricate a wall structure. In particular, the wall panels 100 and

400 are adapted to receive portions of the tie assembly as illustrated in FIG. 19 for example. As best illustrated in FIGS. 1-6, the upper end 104 and lower end 108 of the wall panel 100 may be formed with a plurality of upper and lower tie channels 128, 130. For illustration purposes, the upper channels 128 and upper notches 138 will be described in detail with the understanding that these features may also be present in the lower channels 130 and/or the lower notches 138. As best shown in FIGS. 3, 5 and 6, the upper tie channel 128 may comprise a reinforcing rib channel 129 adapted to receive the reinforcing rib 208 of the tie assembly 200. The upper tie channel further comprises an elongated anchor channel 131 adapted to receive the elongated anchor 204 of the tie assembly 200. As best shown in FIGS. 2-5, the elongated anchor channel 131 may extend below and communicate with the upper notches 138 and thereafter exiting the inner face 136 of the wall panel 100. As best illustrated in FIGS. 1 and 5, the entrance to the elongated anchor channel 131 may have beveled portions 133 or may otherwise be rounded to facilitate insertion of the elongated anchor 204 into the upper tie channel 128. The upper notches 138 are also adapted to receive a portion of the connecting member 206.

FIGS. 21-23 illustrate one embodiment of a corner member 300 in accordance with the present invention. As shown in FIG. 13 the corner member 300 includes a channel member 302 adapted to engage a side edge portion of one of the wall panels. As shown in FIG. 24 for example, corner member 300 engaging a side edge of one wall panel. The corner member 300 includes a outer flange 304 including a protrusion 306 and may be formed with one or more slots 308. As shown in FIG. 21, two slots 308 and a protrusion 306 are formed at a top end of the flange 304 while an identical pair of slots 308 with a protrusion 306 are formed on the bottom end of the flange 304, thereby

allowing corner member 300 to be used in a variety of applications and positions.

As shown in FIG. 24 the outer flange 304 rests against the inner surface 136 of an outer wall panel wherein it will be understood that at least a part of the outer flange 304, such as one of protrusions 306, may at least partially enter into one of the slots 210 and/or one of the slots 222. Allowing the connecting member 206 to engage the corner member 300 in the manner may increase the structural integrity of the corner assembly 310. While only one slot 308 is needed a plurality of slots 308 in a plurality of protrusions 306 may be provided as shown in FIG. 12 in order to increase the versatility of the corner member 304 and allow the corner member 304 to be used in various positions depending on the particular corner of the wall panel in which the corner member 300 is installed.

FIGS. 25-33 of the present invention illustrates a second exemplary embodiment of a tie assembly 500. The tie assembly 500 includes a handle 502 having a elongated anchor 504. The handle 502 includes a connecting member 506 and one or more reinforcing ribs 508 may extend between the elongated anchor 504 and the connecting member 506. Additional protrusions 505 may be formed on the elongated anchor 504 to increase the strength of the connection between the elongated anchor 504 and the tie channels of the wall panels.

FIG. 25 depicts a link 524 that is separate from the handles 502 prior to assembly. The link 524 is designed to interlock with the connecting member 506 of the handles 502. To achieve the interlocking connection, the link 524 is provided with a first half 524a and a second half 524b. The link 524 may be manufactures such that each of the halves 524a and 524b are equal in length. Moreover, the overall length of the link 524 may be fabricated with different lengths depending on the wall space requirements. For instance, any length of link may be used. For instance, the link may be formed with lengths between



3 and 22 inches, for example. Alternatively, the link 524 may be formed from one length that represents the largest distance typically used in which to space walls. One or more of the halves may then be trimmed to the desired length on the field. For instance, as shown in FIG. 28 for example, the end of the first half 524a may be trimmed to size such that a larger amount of teeth 532 exist on the second half 524b than the first half 524a. Although not shown, it will be understood that equal amounts of the link 524 may be trimmed from each half 524a, 524b, such that there are approximately equal amounts of teeth extending from each half.

FIGS. 25-27 further illustrate the unique characteristics of the link 524 in accordance with one exemplary embodiment of the invention. FIG. 26 illustrates a partial sectional view of the link 524 along its elongated axis. As shown in FIG. 26, a plurality of teeth 532 extend from the central shaft 546. While the teeth are illustrated with an angled upper surface, it will be appreciated that other surfaces such as horizontally planar, curved or other shapes may be used within the scope of this invention.

FIGS. 25-27 further illustrate a protrusion 538 such as a bead extending from the central shaft 546. The protrusion(s) 538 may assist in locking the link 524 to the handle 502 once the handle is installed on the link as will be described more fully below.

The connecting member 506 may be formed as a first cage including locking ribs 512 wherein adjacent locking ribs define slots 510. In one particular embodiment the connecting member 506 may be formed with a first side 518 and a second side 520 that connect a first row 534 of locking ribs 512 to a second row 536 of locking ribs 512. The ribs are spaces to allow incremental adjustment of the length of the tie assembly, for instance in increments of half and inch. As shown in FIG. 28, the first row 534 of locking ribs 512 may be offset relative to the second row 536 of locking ribs 512 such that one

locking rib 512 in the first row 534 is located across from a corresponding slot 510 defined between two adjacent locking ribs 512 of the second row 536. It is understood however that the rows 534 and 536 may be aligned such that the ribs 512 of the first row 534 are located directly across from the ribs 512 of the second row 536. Staggering the ribs however may be desirable in order to increase the structural integrity of the tie assembly 500. As best shown in FIGS. 17 and 30, an insertion channel 516 is defined between the first row 534 and the second row 536.

The halves 524a and 524b comprise locking teeth 532 arranged for engaging the connecting member 506. In one embodiment the locking teeth 532 are provided on opposite sides of the link 524 and offset relative to one another in order to be received in the slots 510 defined between the locking ribs 512.

Assembling the tie assembly 500 will now be described. First, two handles 502 and a link 524 are provided as illustrated in the exploded view of the tie assembly 500 shown in FIG. 32. The link 524 is the same as the link illustrated in FIGS. 25-27 wherein the details of the link 524 are better illustrated in FIGS. 25-27. If necessary, the link may be trimmed according to the desired spacing between the wall panels. To provide an assembled tie assembly 500, as illustrated in FIG. 33, the first end of the first half 524a is first inserted into an insert channel 516 of a connecting member 506. As shown in FIG. 30, the insert channel 516 is formed with a keyed shape. FIGS. 26 and 27 also depict the link 524 fabricated in a similar keyed manner. In one embodiment, the link 524 is formed with parallel substantially flat sides 540 spaced across from each other by a thickness indicated by reference number 542 in FIG. 27. As shown in FIG. 26, the vertical height between the outer portions of the teeth, indicated by reference character 544, is larger than the thickness 542 of the keyed link 524. The first end of the first half 524a is inserted

into the keyed insert channel 516 such that the teeth 532 of the line 524 extend towards the first side 518 and the second side 520. In one embodiment, the distance between the first and second sides 518, 520 in the insert channel is greater than or equal to the tooth height 544, thereby allowing the end portion of the first half 524a, to be sliding channel 516 with relatively little, if any, interference with the connecting member 506. The link 524 may be inserted partially within the insert channel or may be inserted until an end of the link 524 abuts an inside portion of the elongated anchor 504. Once inserted, the handle 502 is rotated relative to the link 524 approximately 90 degrees such that the locking teeth 532 at least partially enter into the slots 510 defined between adjacent teeth 512. Once fully rotated, the protrusions 538 may engage an interior surface of one or more ribs 512 inside the insert channel 516. Engagement of the protrusions 538 helps lock the link 524 into position within the connecting member 506, thereby discouraging unintended rotational movement of the link relative to the handle 502. The same process is repeated for the second handle 502 wherein the second half 524b of the link 524 is inserted into the insert channel 516 of the connecting member 506 of the second handle 502. The second handle 502 is also rotated approximately 90 degrees such that the teeth 532 at least partially enter into corresponding slots 510 defined between adjacent ribs 512 of the connecting member 506.

The ribs 512 along with the locking teeth 532 may be designed such that they frictionally engaged one another once the handles 502 are rotated into place on the link 524. For instance, as shown in FIG. 18, the ribs are formed at slight angles relative to one another. In one embodiment, the surfaces are oriented at approximately 1.5 degrees from the vertical, and therefore, approximately 3 degrees relative to one another in order to encourage a frictional interference with the teeth 532. Each of the tie assemblies

described above may be formed from many different materials such as plastics or other materials and may be molded during a process such as an injection molding process.

A wall structure 700, as shown in FIG. 38, may be formed with the concepts of the present invention. For instance, a first and second lower wall panel 400 may be provided and anchored to a ground surface by ground anchors 706 as depicted in FIG. 38. Tie assemblies 500 may be assembled in the manner described above and thereafter inserted in corresponding tie channels defined in the wall panels 400. Next, concrete 708, filler, or other structural material may be filled into the space defined between the wall panels 400. Next, successive vertical wall panels 100, may be inserted over the wall panels 400 with the elongated anchors received in corresponding lower tie channels of the wall panels 100. Concrete 708, filler, or other structural material is further added to fill the channels defined between the offset walls. Finally, the upper portion may be flared outward with an additional tie assembly 500 and filled with concrete 708, filler or other structural material.

FIG. 37 depicts another exemplary embodiment of a corner assembly 810 in accordance to the present invention. The corner assembly includes an outer corner member 812 and an inner corner member 814. FIGS. 34-36 illustrate an exemplary embodiment of an outer corner member 812 in accordance with the present invention. The outer corner member 812 may include a first elongated panel 816 and a second elongated panel 818 joined together at an attachment location 820. A tie channel 822 may be defined at the attachment location 820. The corner members 812, 814, may comprise upper and lower tongues and grooves. For example, the outer corner 812 may comprise an upper tongue 824 and lower tongue 828, upper groove 826 and lower groove 830 in order to interlock with other vertically offset corner members. Moreover, the corner

members may further comprise lateral tongues and grooves designed to abut the ends of the adjacent wall panels. For instance, the outer corner member 812 may be provided with a groove 832 and a tongue 834 for engaging portions of corresponding wall panels 100 as illustrated in FIG 37.

5           The inner corner member 814 is constructed in a similar manner as the outer corner member 812 except the inner corner member 814 is provided with three tie channels. As illustrated in FIG. 37, one of the tie assemblies 500 is partially inserted in a tie channel 128 of one of the outer wall panels 100. Another tie assembly 500 is inserted at least partially in the second tie channel 836 of the inner corner member 814 and at least  
10           partially in the upper tie corner 128 of another wall panel 100. Finally, a third tie assembly 500 is partially inserted in the third tie channel 840 and the tie channel 822 of the outer corner member 812.

          The foregoing description of the various embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be  
15           exhaustive or to limit the invention to the precise form disclosed. Many alternatives, modifications and variations will be apparent to those skilled in the art of the above teaching. Some of these alternatives have been discussed specifically, while others will be apparent or relatively easily developed by those of ordinary skill in the art. Accordingly, this invention is intended to embrace all alternatives, modifications and  
20           variations that have been discussed herein, and others that fall within the spirit and broad scope of the claims.

**WHAT IS CLAIMED IS:**

1. A wall panel adapted to interlock with another vertically offset panel and adapted for connection with a tie to another laterally offset panel, the wall panel comprising:

a) an upper end including an upper edge and a lower end including a lower edge;

5 b) an upper tongue extending from the upper edge and an upper groove defined in the upper end; and

c) an upper tie channel defined in the upper end and adapted to receive a portion of a tie.

2. The wall panel of claim 1, wherein the upper groove is in communication with the upper tie channel.

3. The wall panel of claim 1, wherein the wall panel has a front face and a rear face, an upper notch is at least partially defined by the upper edge, and the upper notch extends from the front face to the upper groove.

4. The wall panel of claim 1, wherein the wall panel has a front face and a rear face, an upper notch is defined by the upper edge, and the upper notch extends from the front face to the tie channel.

5. The wall panel of claim 4, wherein the upper notch is further defined by the upper tongue.

6. The wall panel of claim 4, further comprising a lower tongue extending from the lower edge, a lower groove defined in the lower end, and a lower tie channel defined in the lower end and adapted to receive a portion of a tie.
7. The wall panel of claim 6, further comprising a lower notch defined in the lower edge, the lower notch extending from the front face to the lower groove.
8. The wall panel of claim 7, wherein the upper notch and the lower notch are aligned along a vertical line and the upper tie channel and the lower tie channel are aligned along the vertical line.
9. The wall panel of claim 8, wherein the upper notch is further defined by the upper tongue.
10. The wall panel of claim 1, wherein the upper end extends substantially along a first plane and the lower end extends substantially along a second plane, the wall panel further comprising an intermediate portion extending substantially along a third plane, wherein the third plane intersects the first and second planes.
11. The wall panel of claim 10, wherein the first plane is substantially parallel to the second plane.
12. The wall panel of claim 10, wherein the lower end defines a through channel including two open ends, wherein the through channel is adapted to receive a stake

through the two open ends for mounting the wall panel to a support surface.

13. A substantially H-shaped tie assembly adapted to connect two wall panels together, the tie assembly comprising:

a) a first handle including a first elongated anchor and a first connecting member attached to the first elongated anchor;

5 b) a second handle including a second elongated anchor and a second connecting member attached to the second elongated anchor; and

c) a link having a first end connected to the first connecting member and a second end connected to the second connecting member.

14. The tie assembly of claim 13, wherein the first handle and the second handle are each substantially T-shaped.

15. The tie assembly of claim 13 wherein the first and second elongated anchors are formed as elongated tongue members having a substantially flat outer surface and a substantially flat inner surface, the first connecting member extends from the inner surface of the first elongated anchor and the second connecting member extends from the inner surface of the second elongated anchor.

16. The tie assembly of claim 15, further comprising at least one protrusion extending from the outer surface of each of the first and second elongated anchors.



17. The tie assembly of claim 15, wherein at least one reinforcing rib extends from the first connecting member to the inner surface of the first elongated anchor and at least another reinforcing rib extends from the second connecting member to the inner surface of the second elongated anchor.

18. The tie assembly of claim 13, wherein the first connecting member comprising a first cage and second connecting member comprising a second cage, wherein each of the cages include locking ribs for connecting the cages to corresponding ends of the link.

19. The tie assembly of claim 18, wherein the link is comprised of a first elongated half and a second elongated half, the first elongated half being integrally connected to the first cage at the first end of the link and the second elongated half being integrally connected at to the second cage at the second end of the link, the first elongated half being  
5 interlocked with second cage at the second end of the link and the second elongated half being interlocked with the first cage at the first end of the link.

20. The tie assembly of claim 18, wherein slots are defined between the ribs of the cages and wherein the ends of the link comprise protrusions extending into the slots to interlock the link with the handles.

21. The tie assembly of claim 20, wherein the link is removably interlocked with the handles, wherein the protrusions of the first end of the link are capable of disengaging the slots of the first cage after rotating the first handle 90 degrees relative to the link such that the first end of the link is capable of being removed from the first cage and wherein the

5 protrusions of the second end of the link are capable of disengaging the slots of the second cage after rotating the second handle 90 degrees relative to the link such that the second end of the link is capable of being removed from the second cage.

22. The tie assembly of claim 20, wherein each of the cages are formed with a first row of ribs extends along a first side of the cage and defines a first row of slots and a second row of ribs extends along a second side of each of the cages and defines a second row of slots, each of the ends of the link have two rows of protrusions engaging  
5 corresponding ones of the slots in each row of slots.

23. The tie assembly of claim 20, wherein at least one of the ribs of the first row of ribs of each of the cages is offset from the corresponding second row of ribs of each of the cages such that at least one of the ribs of the first row of ribs is aligned with at least one of the slots defined by the second row of ribs.

24. The tie assembly of claim 13, wherein the handle comprises protrusions for increased structural connection.

25. A corner assembly for connecting a first outer wall to a second outer wall and a first inner wall to a second inner wall, the corner assembly comprising:

a) an outer corner member including an upper end with an upper edge, the upper end of the outer corner member defines an upper channel, wherein the outer corner member is adapted to connect a first outer wall to a second outer wall; and  
5

b) an inner corner member including an upper end with an upper edge, the upper

end of the inner corner member defines an upper channel, wherein the inner corner member is adapted to connect a first inner wall to a second inner wall.

26. A corner assembly of claim 25, wherein the outer corner member comprises a first elongated panel and a second elongated panel attached to the first elongated panel at an outer attachment location and wherein the inner corner member comprises a first elongated panel and a second elongated panel, wherein the first elongated panel of the inner corner member is attached to the second elongated panel of the inner corner member at an inner attachment location, wherein the upper channel of the outer corner member is defined at the outer attachment location and wherein the upper channel of the inner corner member is defined at the inner attachment location.

27. A wall structure comprising,

- a) a first lower panel including an upper end with an upper edge, the upper end of the first lower panel defining a first lower channel;
- b) a first lower tongue extending from the upper edge of the first lower panel and a first lower groove defined in the upper end of the first lower panel;
- c) a second lower panel including an upper end with an upper edge, the upper end of the second lower panel defining a second lower channel, the second lower panel being laterally offset from the first lower panel;
- d) second lower tongue extending from the upper edge of the second lower panel and a second lower groove defined in the upper end of the second lower panel;
- e) a substantially H-shaped tie assembly comprising a first handle, a second handle, and a link having a first end connected to the first handle and a second end connected to

the second handle, wherein a lower portion of the first handle is received in the first lower channel, and a lower portion of the second handle is received in the second lower channel;

15 f) a first upper panel including a lower end with a lower edge, the lower end of the first upper panel defining a first upper channel, an upper portion of the first handle being received in the first upper channel;

g) a first upper tongue extending from the lower edge of the first upper panel and a first upper groove defined in the lower end of the first upper panel, wherein the first  
20 upper tongue of the first upper panel is received in the first lower groove of the first lower panel and wherein the first lower tongue of the first lower panel is received in the first upper groove of the first upper panel;

h) a second upper panel including a lower end with a lower edge, the lower end of the second upper panel defining a second upper channel, an upper portion of the second  
25 handle being received in the second upper channel, and wherein the second upper panel is laterally offset from the first upper panel; and

i) a second upper tongue extending from the lower edge of the second upper panel and a second upper groove defined in the lower end of the second upper panel, wherein the second upper tongue of the second upper panel is received in the second lower groove  
30 of the second lower panel and wherein the second lower tongue of the second lower panel is received in the second upper groove of the second upper panel.

28. A wall structure comprising,

a) a first lower panel including an upper end with an upper edge, the upper end of the first lower panel defining a first lower channel;

b) a second lower panel including an upper end with an upper edge, the upper end

5 of the second lower panel defining a second lower channel, the second lower panel being laterally offset from the first lower panel;

c) a substantially H-shaped tie assembly comprising a first handle including a first elongated anchor and a first connecting member attached to the first elongated anchor, a second handle including a second elongated anchor and a second connecting member  
10 attached to the second elongated anchor, and a link having a first end connected to the first connecting member and a second end connected to the second connecting member, wherein a lower portion of the first handle is received in the first lower channel, and a lower portion of the second handle is received in the second lower channel;

d) a first upper panel including a lower end with a lower edge, the lower end of  
15 the first upper panel defining a first upper channel, an upper portion of the first handle being received in the first upper channel; and

e) a second upper panel including a lower end with a lower edge, the lower end of the second upper panel defining a second upper channel, an upper portion of the second handle being received in the second upper channel, and wherein the second upper panel  
20 is laterally offset from the first upper panel.

29. A wall structure comprising,

a) a first outer panel including a side end and an upper end with an upper edge, the upper end of the first outer panel defining an outer channel;

b) a second outer panel including a side end and an upper end with an upper edge,  
5 the upper end of the second outer panel defining an outer channel;

c) an outer corner member including an upper end with an upper edge, the upper end of the outer corner member defines an upper channel, wherein the side end of the first

outer panel is positioned adjacent the outer corner member and wherein the side end of the second outer panel is positioned adjacent the outer corner member;

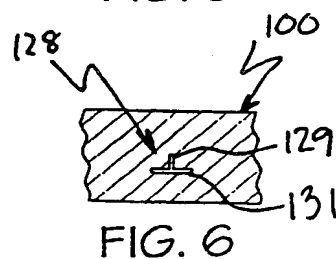
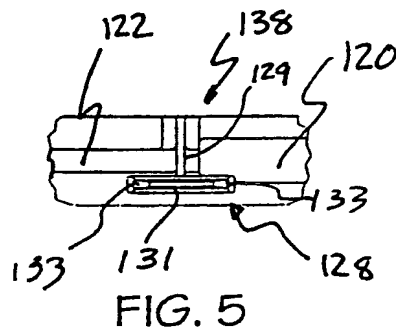
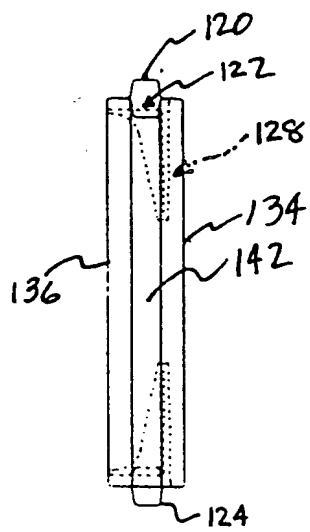
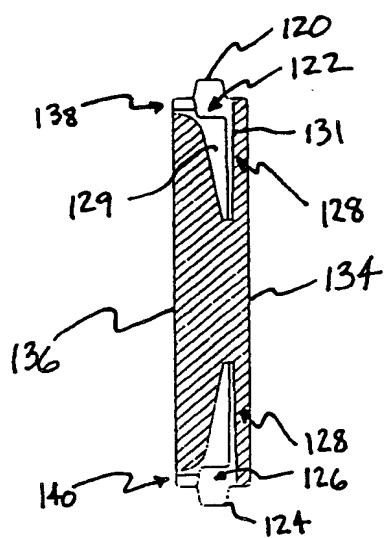
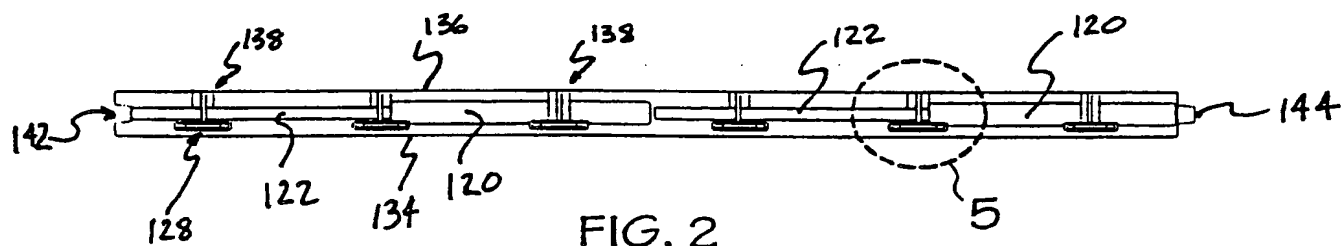
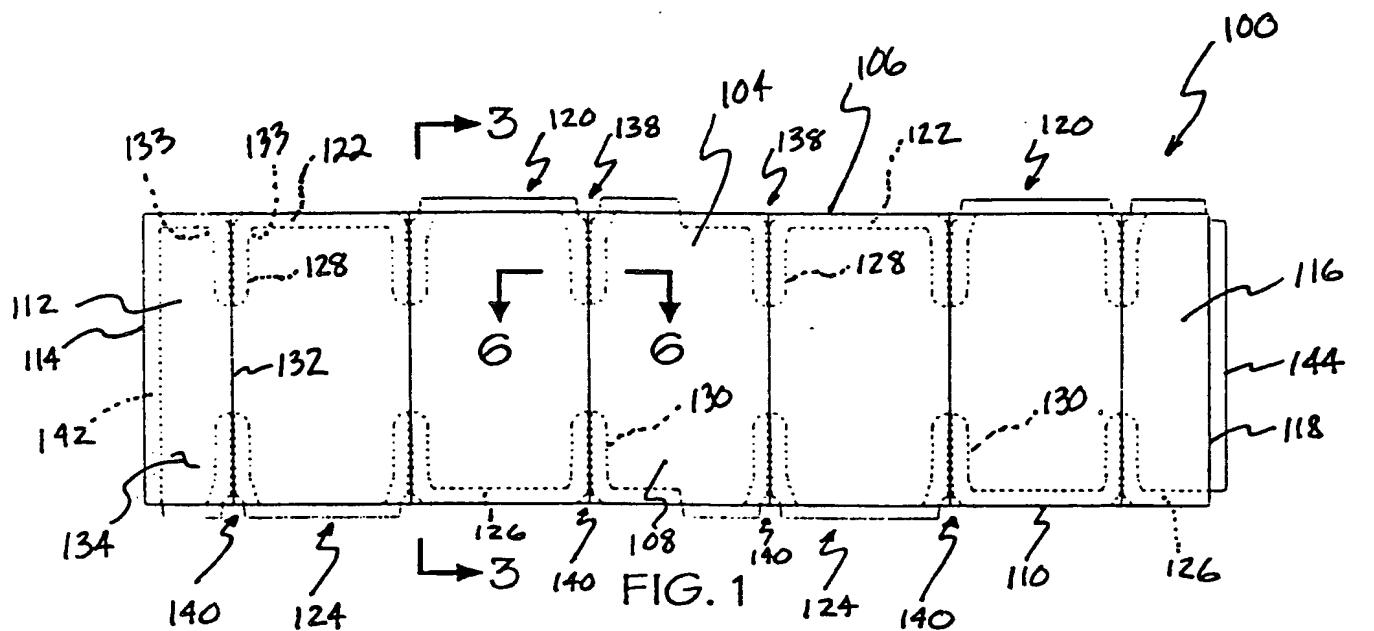
10           d) an inner corner member including an upper end with an upper edge, the upper end of the inner corner member defines a first channel, a second channel, and a third channel; and

          e) three substantially H-shaped tie assemblies, each tie assembly comprising a first handle, a second handle, and a link having a first end connected to the first handle and a  
15           second end connected to the second handle, wherein a lower portion of the first handle of the first of the three substantially H-shaped tie assemblies is positioned in the outer channel of the first outer panel and a lower portion of the second handle of the first substantially H-shaped tie assembly is received in the first channel of the inner corner, a  
20           lower portion of the first handle of the second of the three substantially H-shaped tie assemblies is positioned in the outer channel of the second outer panel and a lower portion of the second handle of the second substantially H-shaped tie assembly is received in the second channel of the inner corner, and a lower portion of the first handle of the third of the three substantially H-shaped tie assemblies is positioned in the upper channel of the outer corner and a lower portion of the second handle of the third substantially H-shaped  
25           tie assembly is received in the third channel of the inner corner.

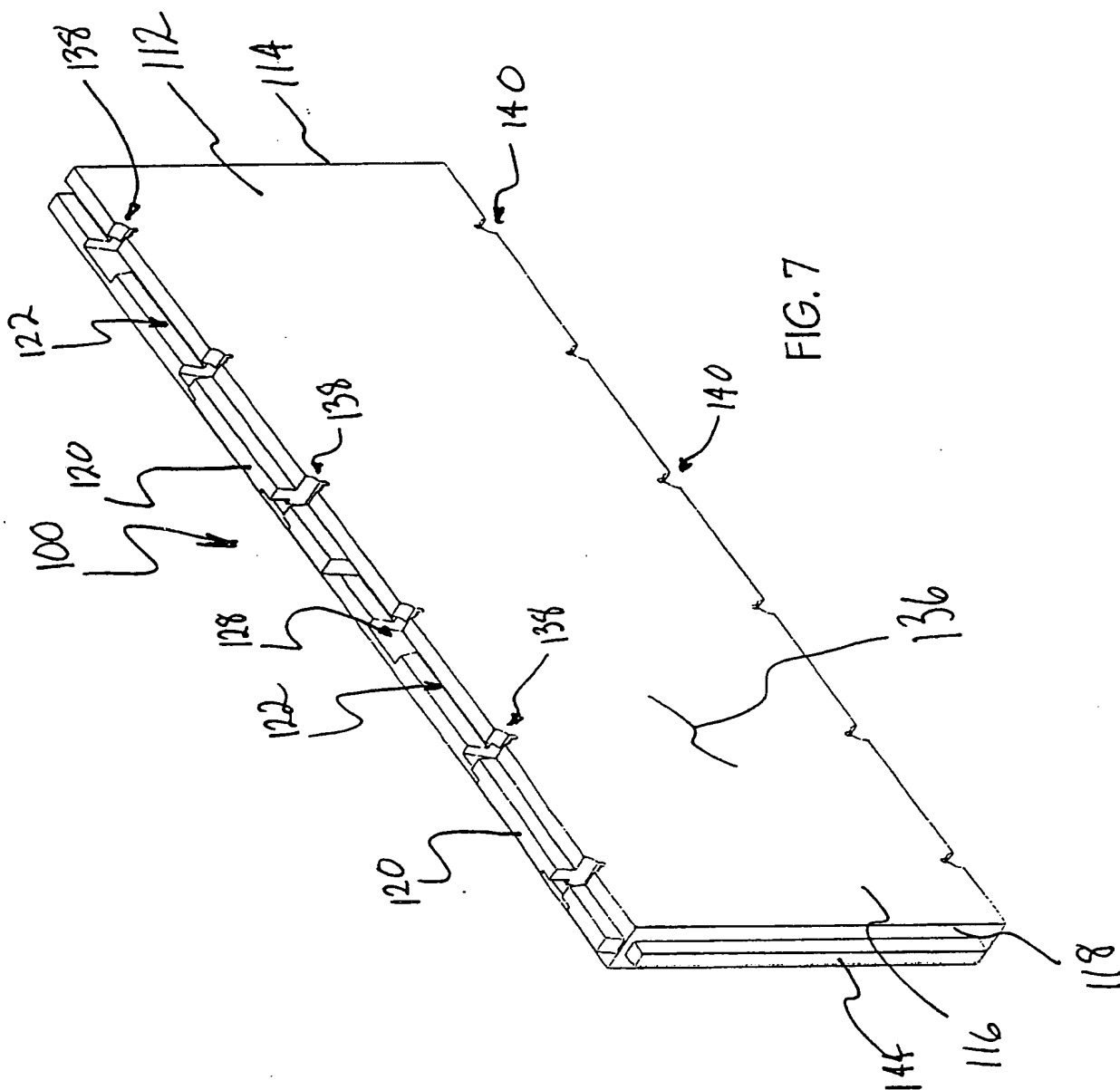
30.       The wall structure of claim 29, wherein the link of the first tie assembly extends along a first directional vector, the link of the second tie assembly extends along a second directional vector, and the link of the third tie assembly extends along a third directional vector, wherein the first directional vector and second directional vector are  
5           approximately normal to one another and wherein the third directional vector extends at

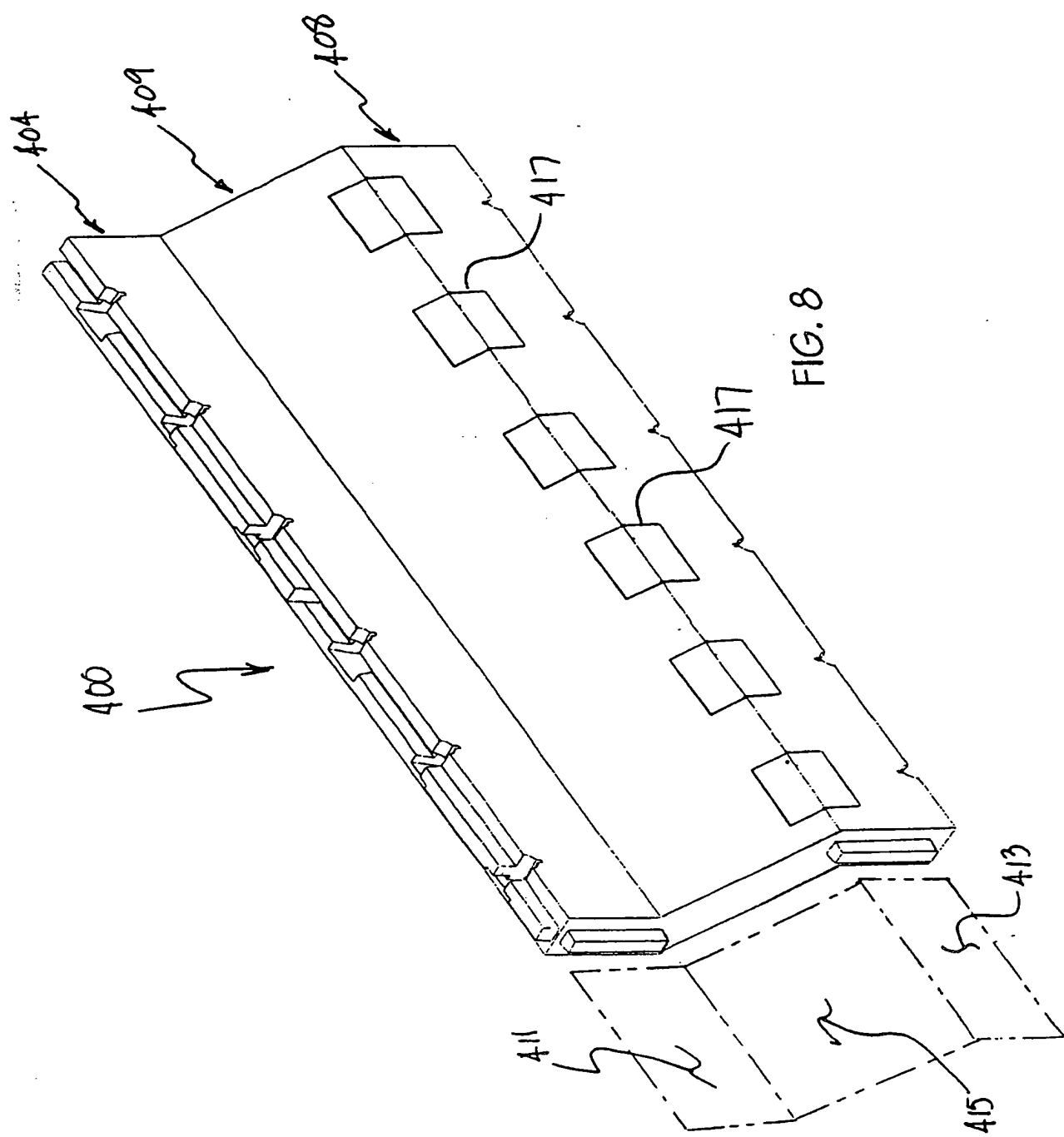
an angle relative to each of the first directional vector and the second directional vector.

31. The wall structure of claim 30, wherein the first directional vector and the second directional vector intersect to substantially form a right angle and wherein the third directional vector substantially bisects the right angle.









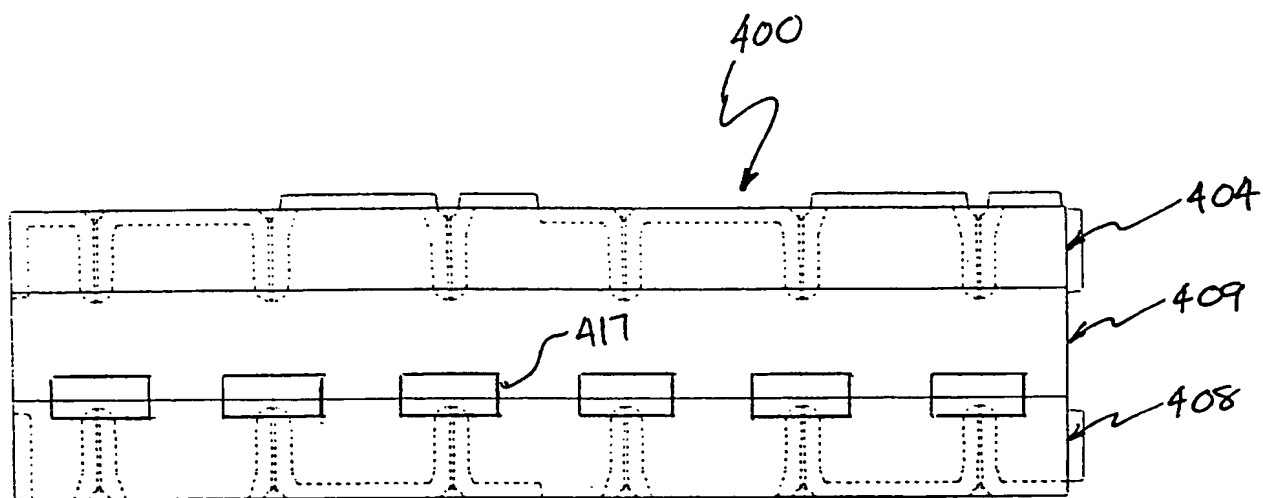


FIG. 9

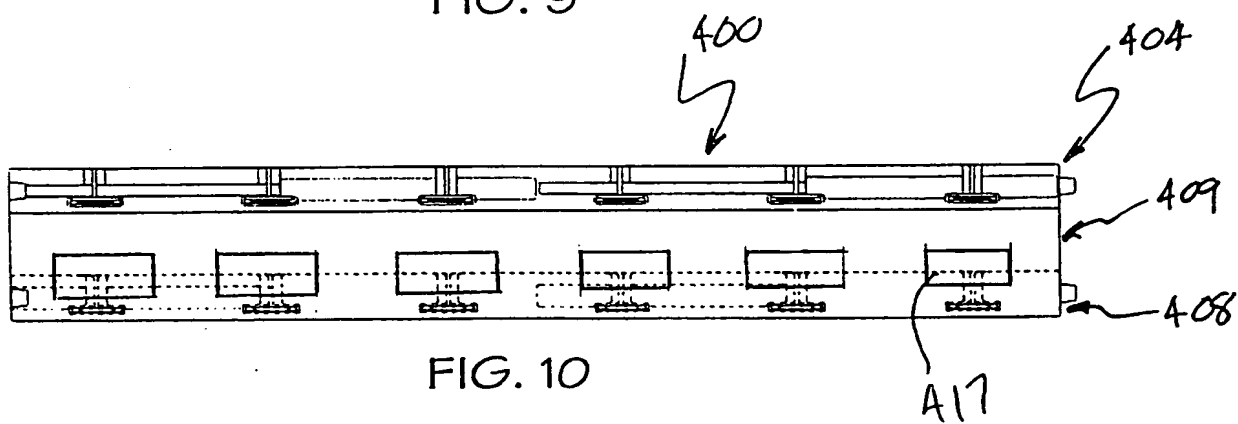


FIG. 10

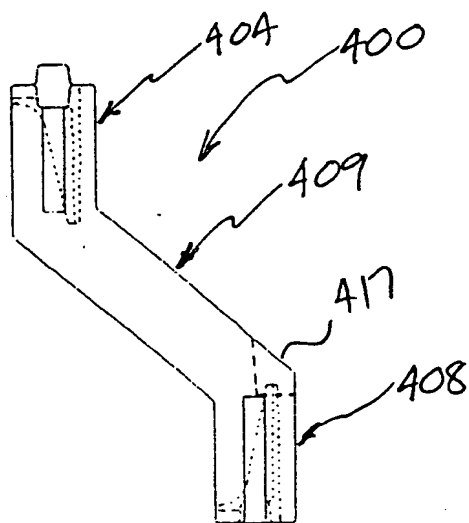
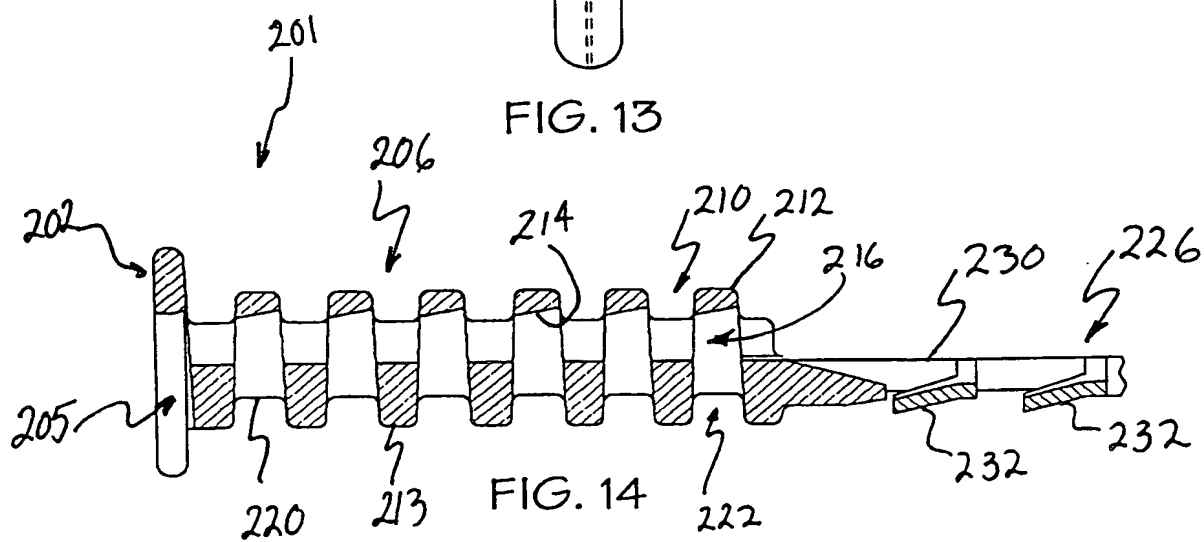
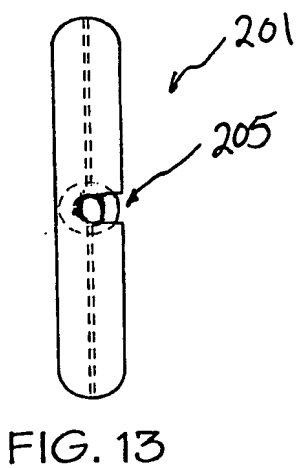
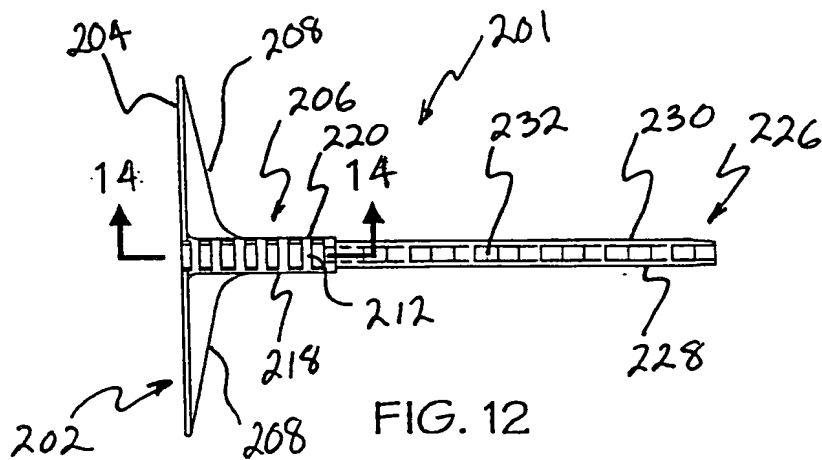
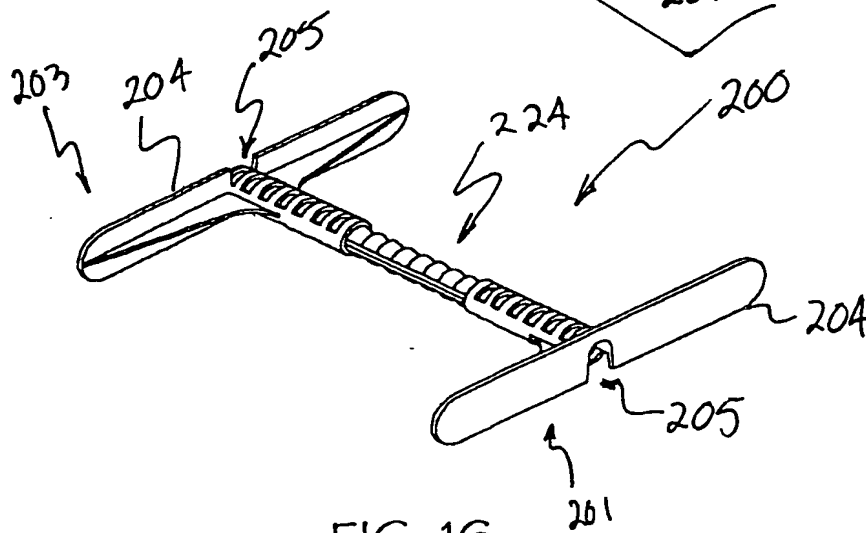
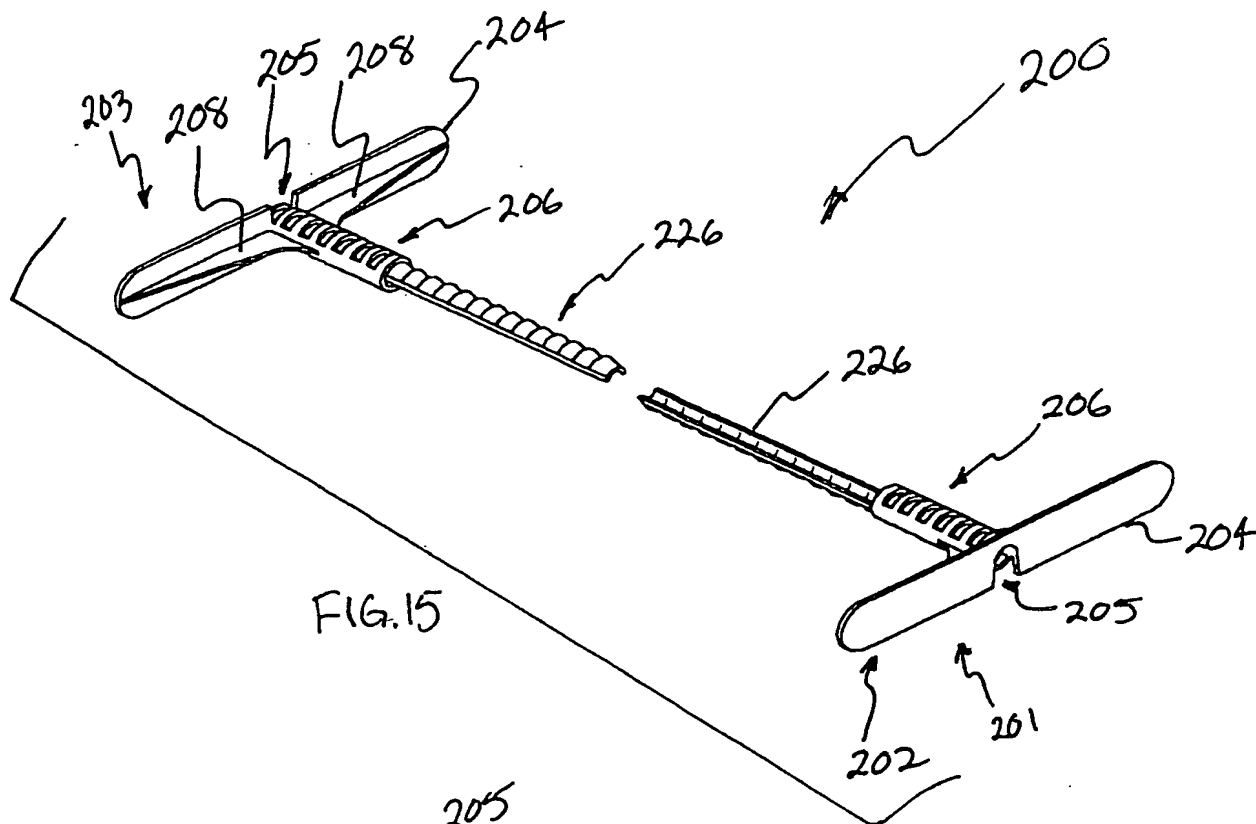
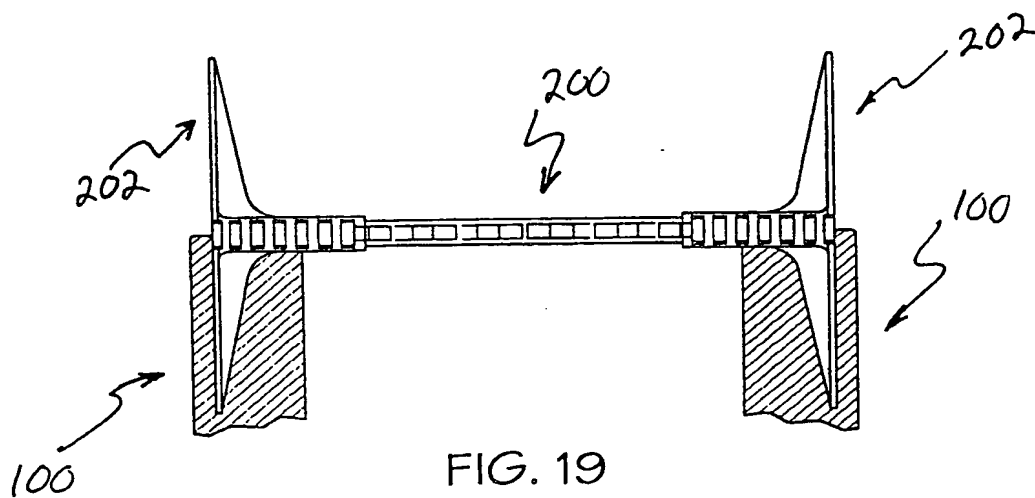
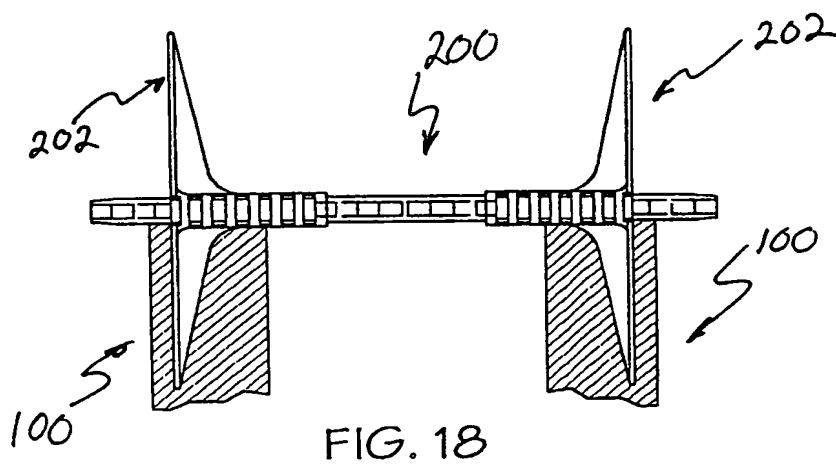
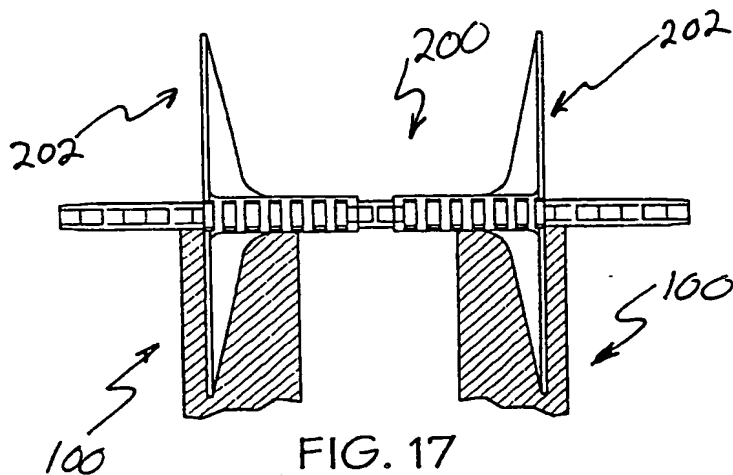
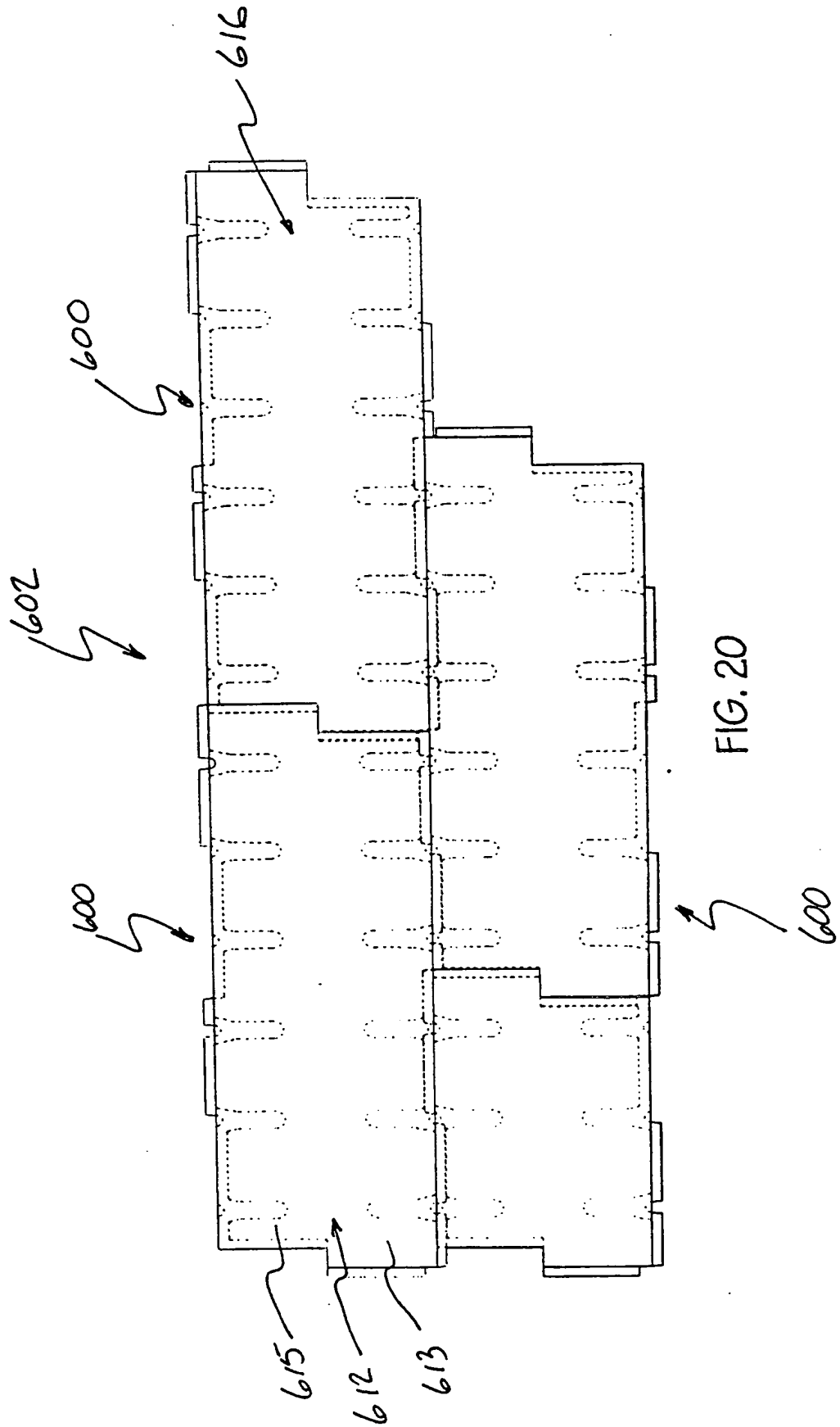


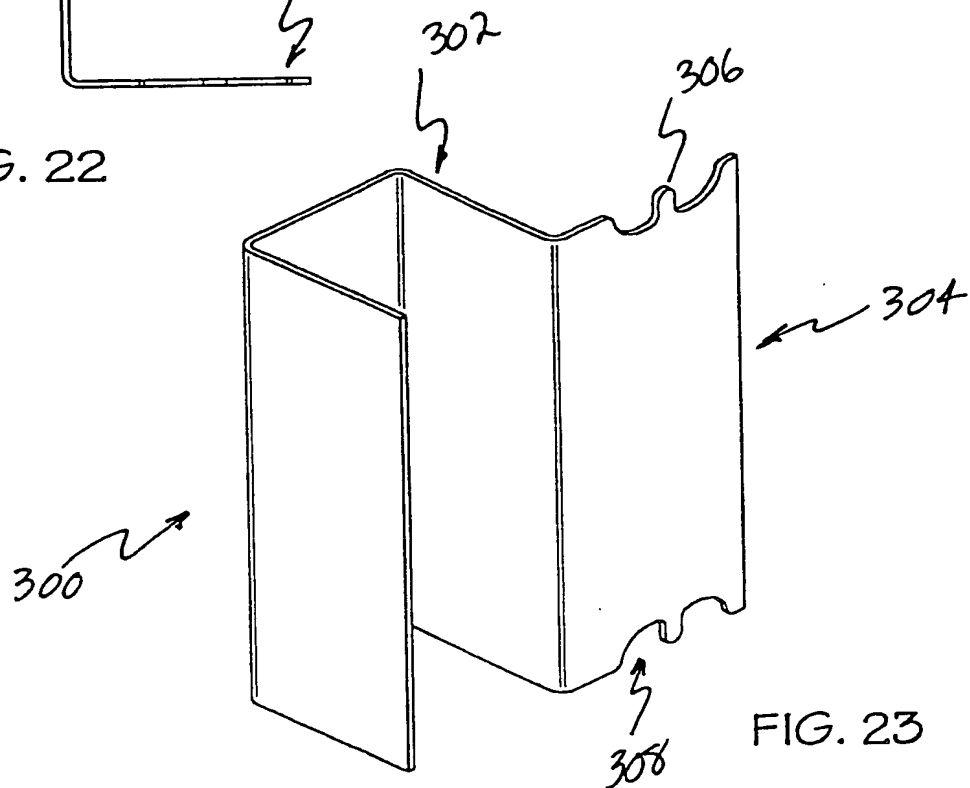
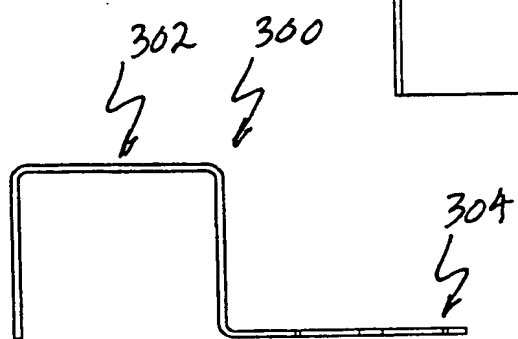
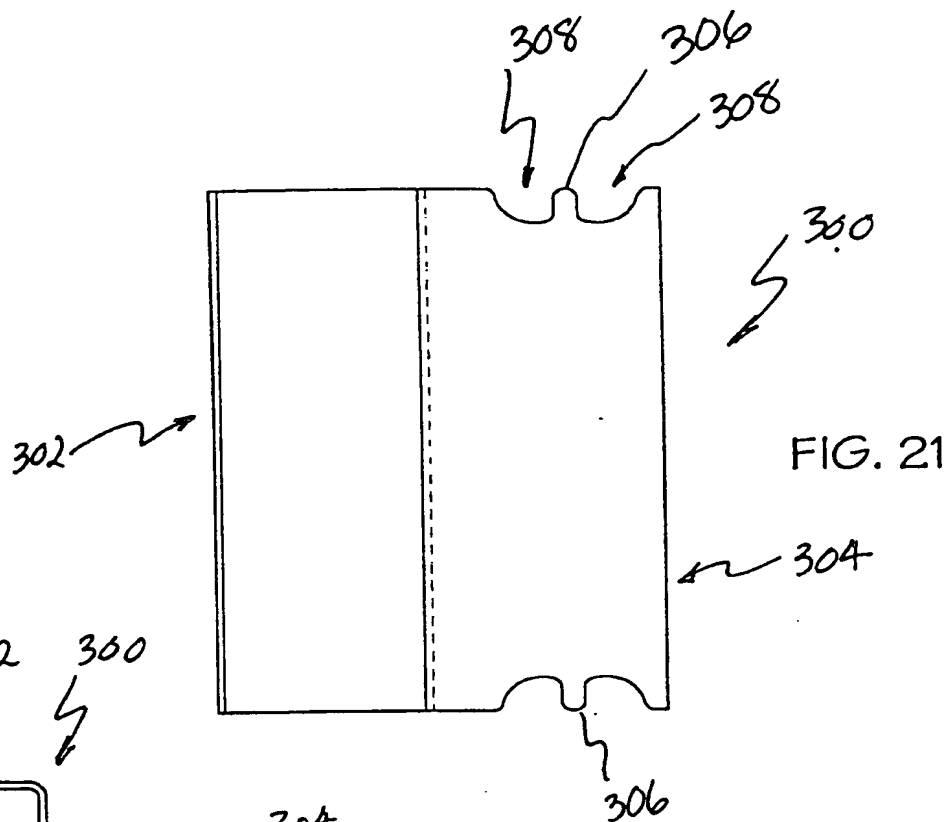
FIG. 11













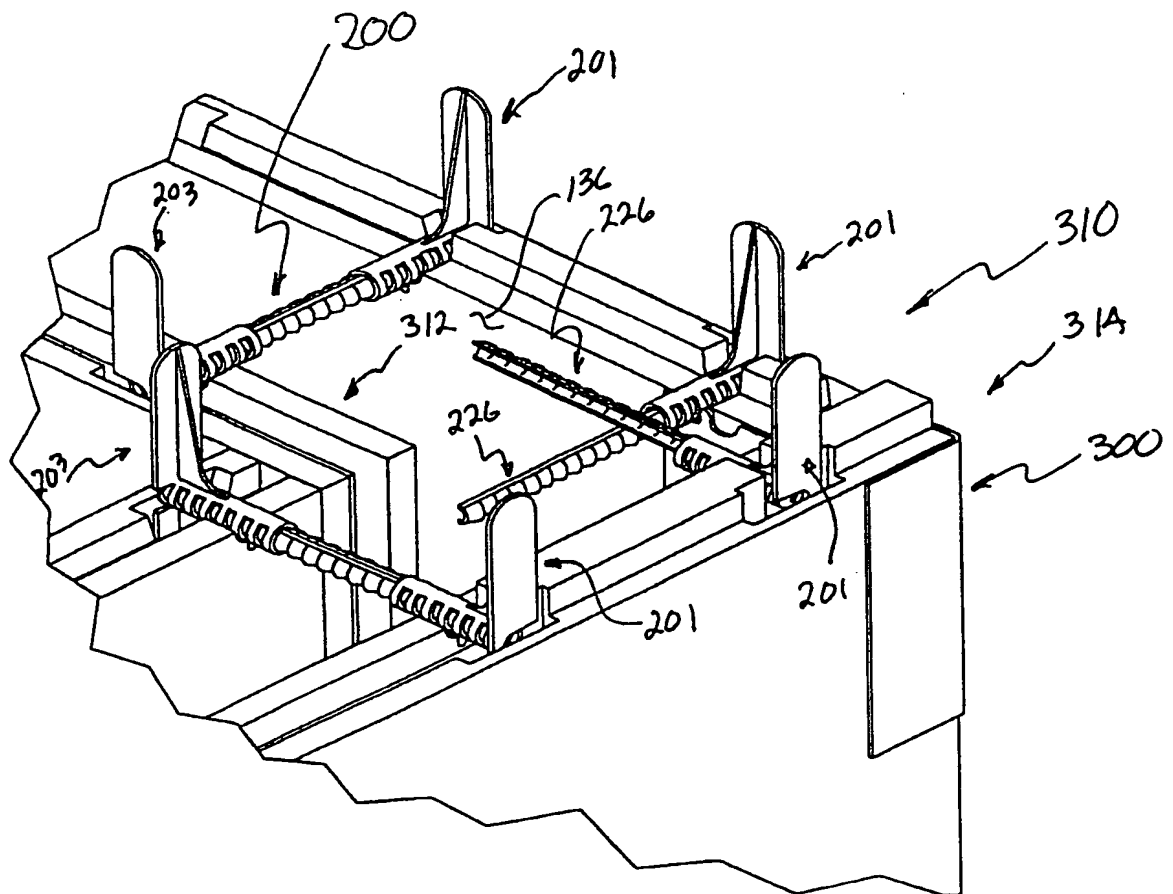
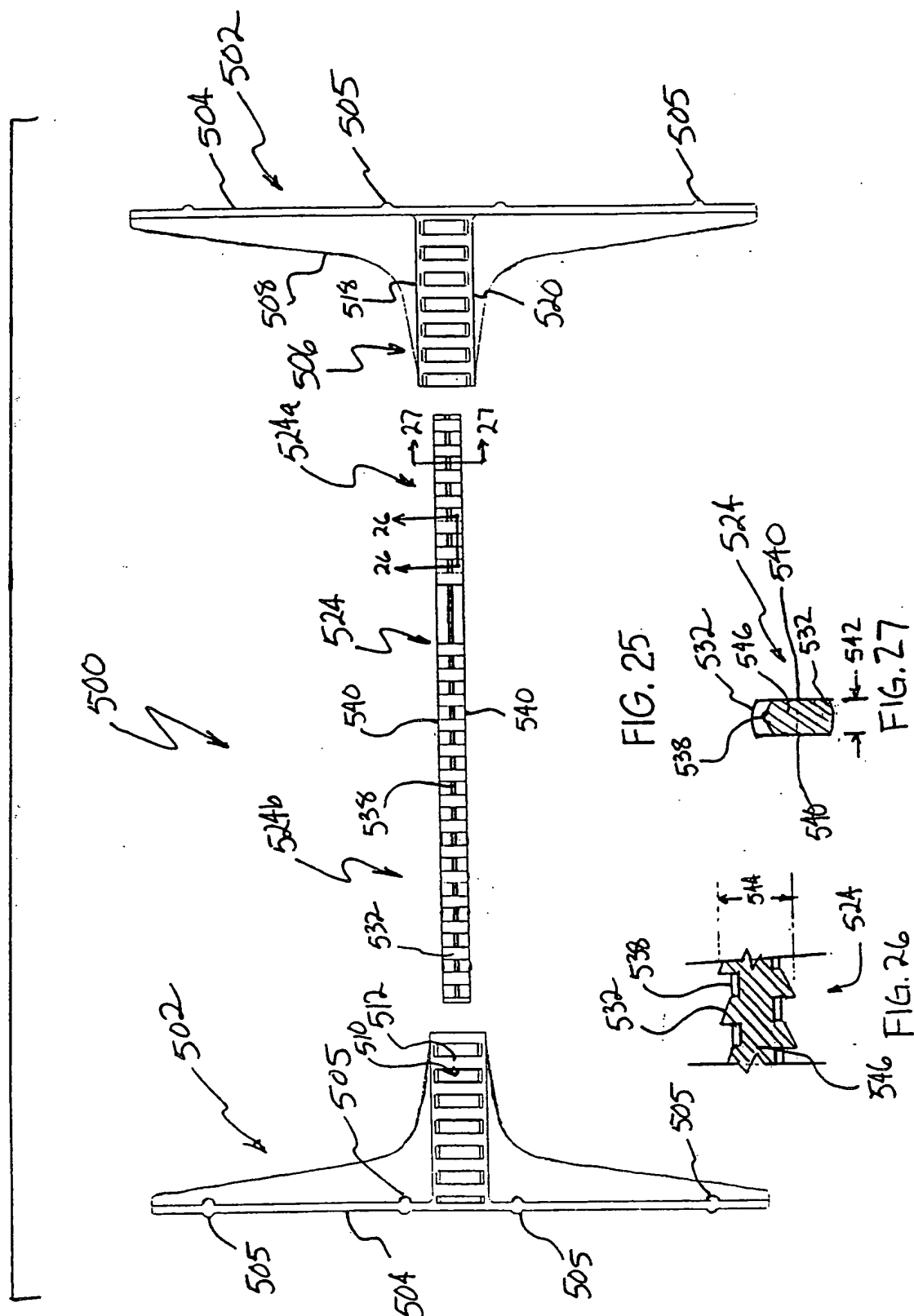


FIG. 24



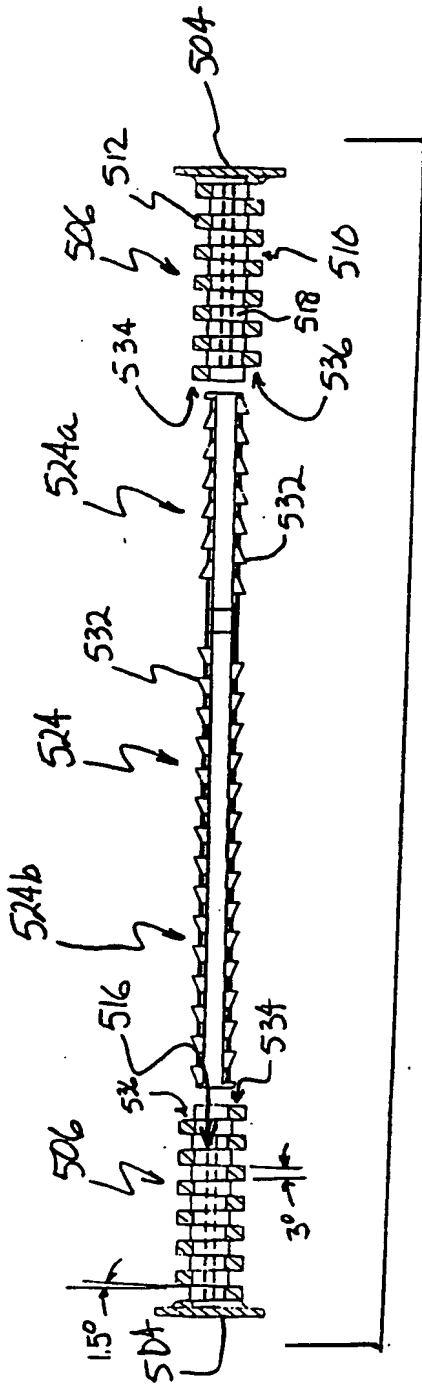


FIG. 28

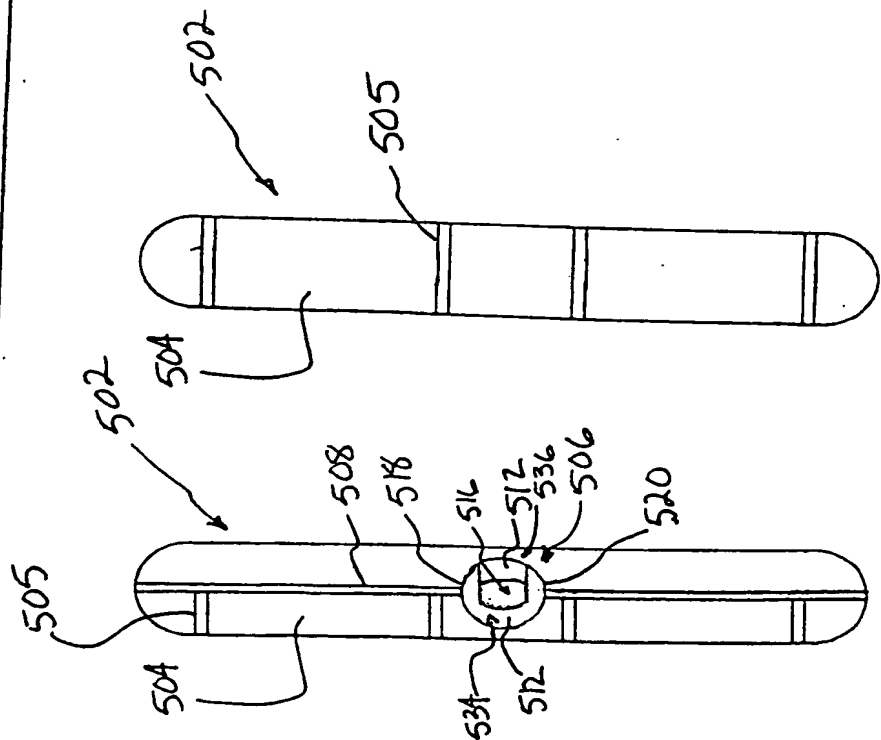


FIG. 30

FIG. 31

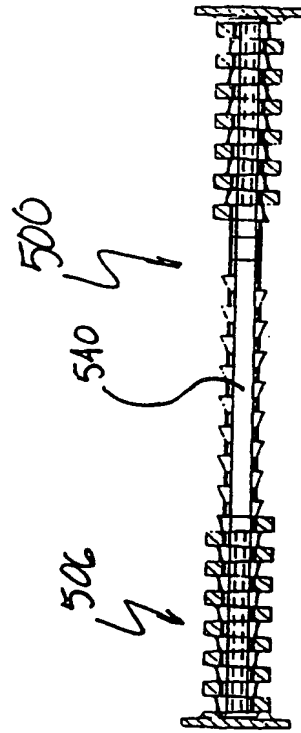
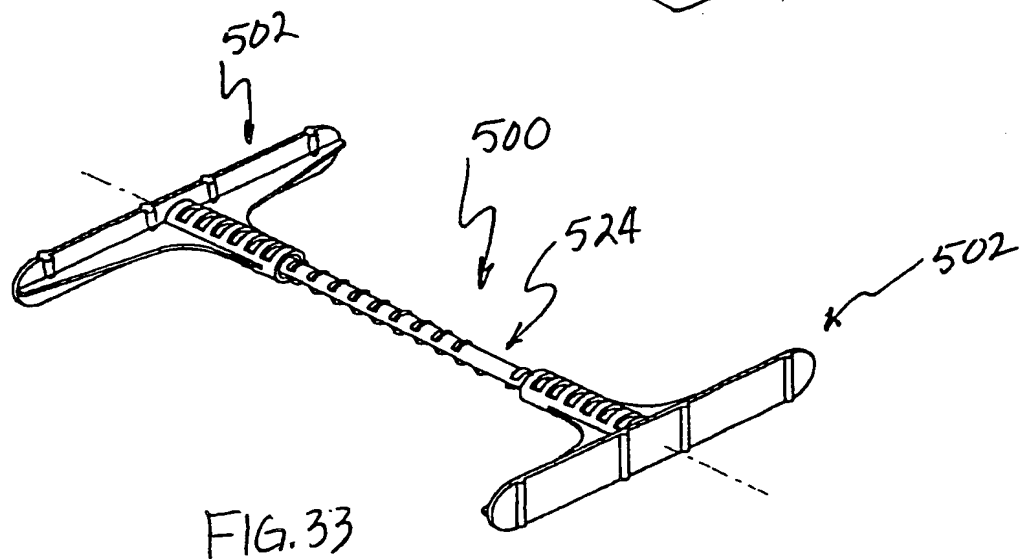
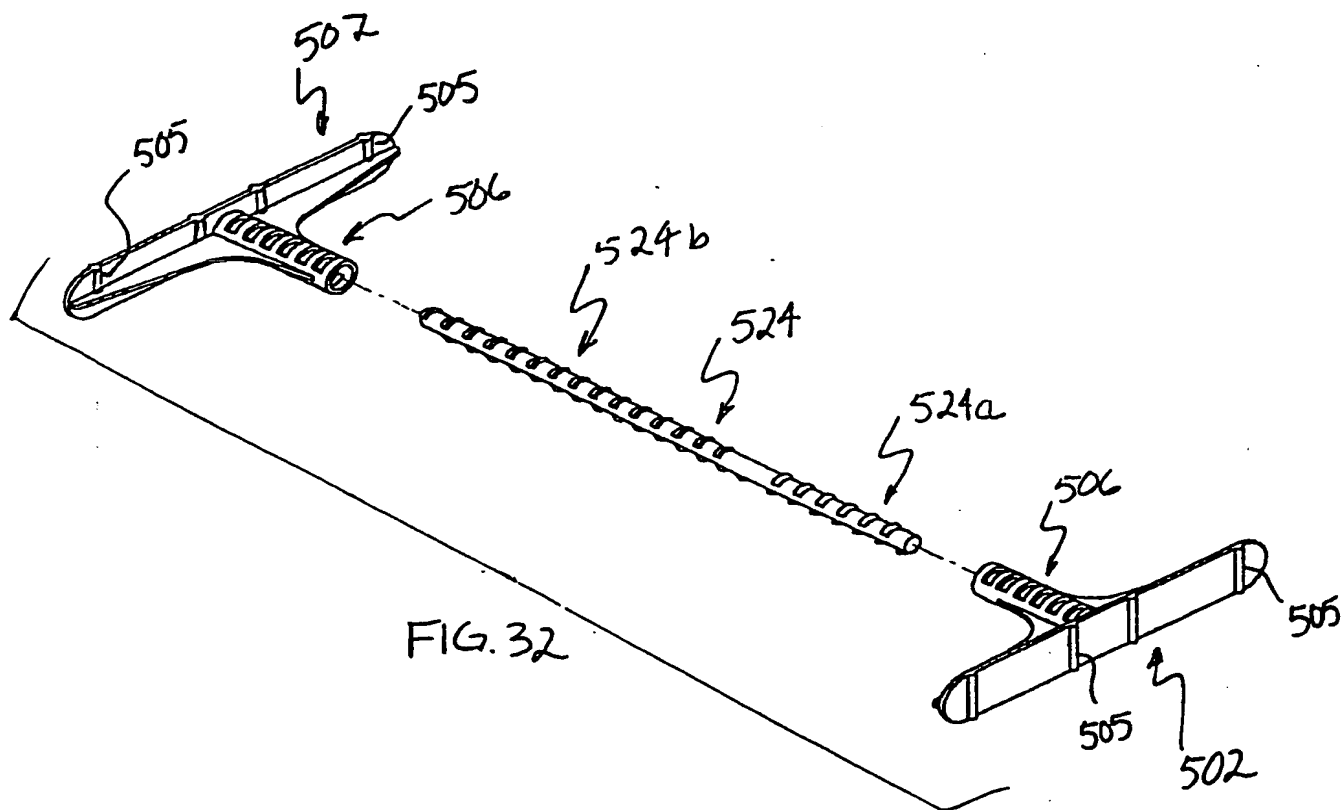


FIG. 29



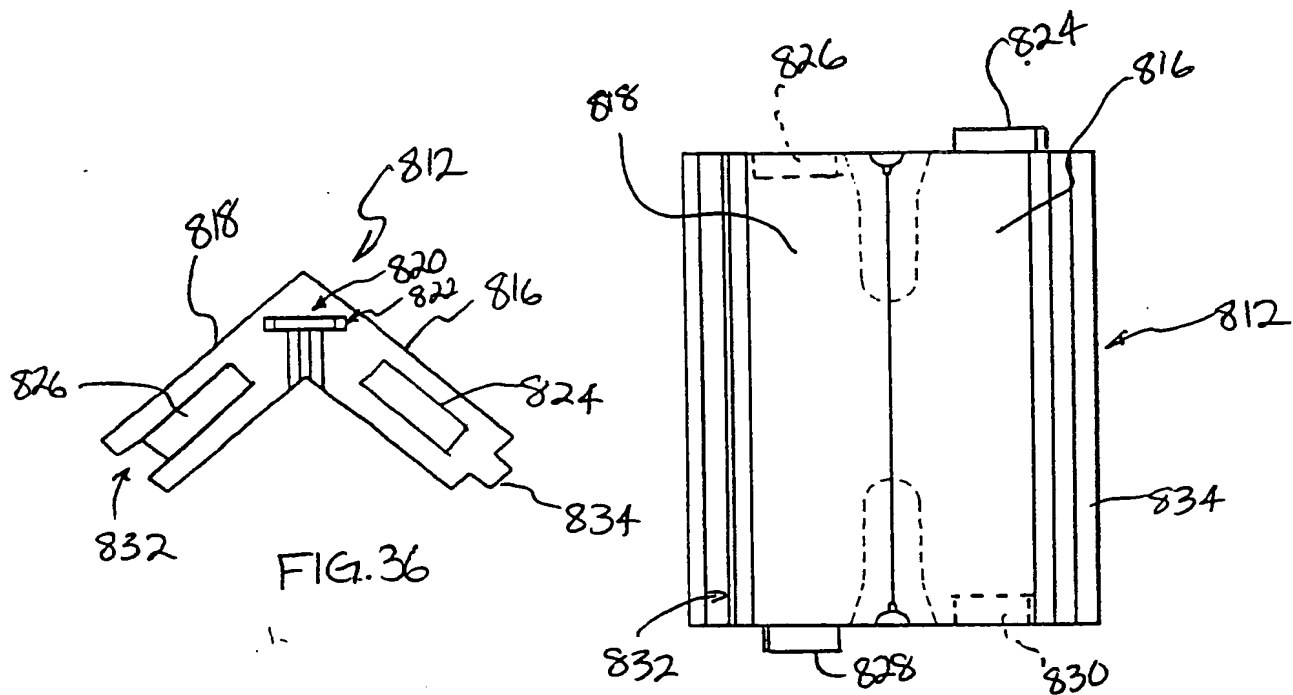


FIG. 36

FIG. 35

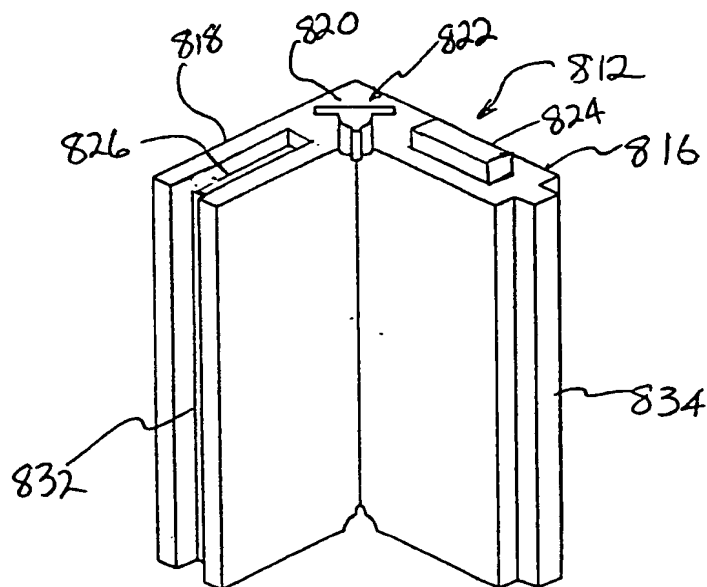
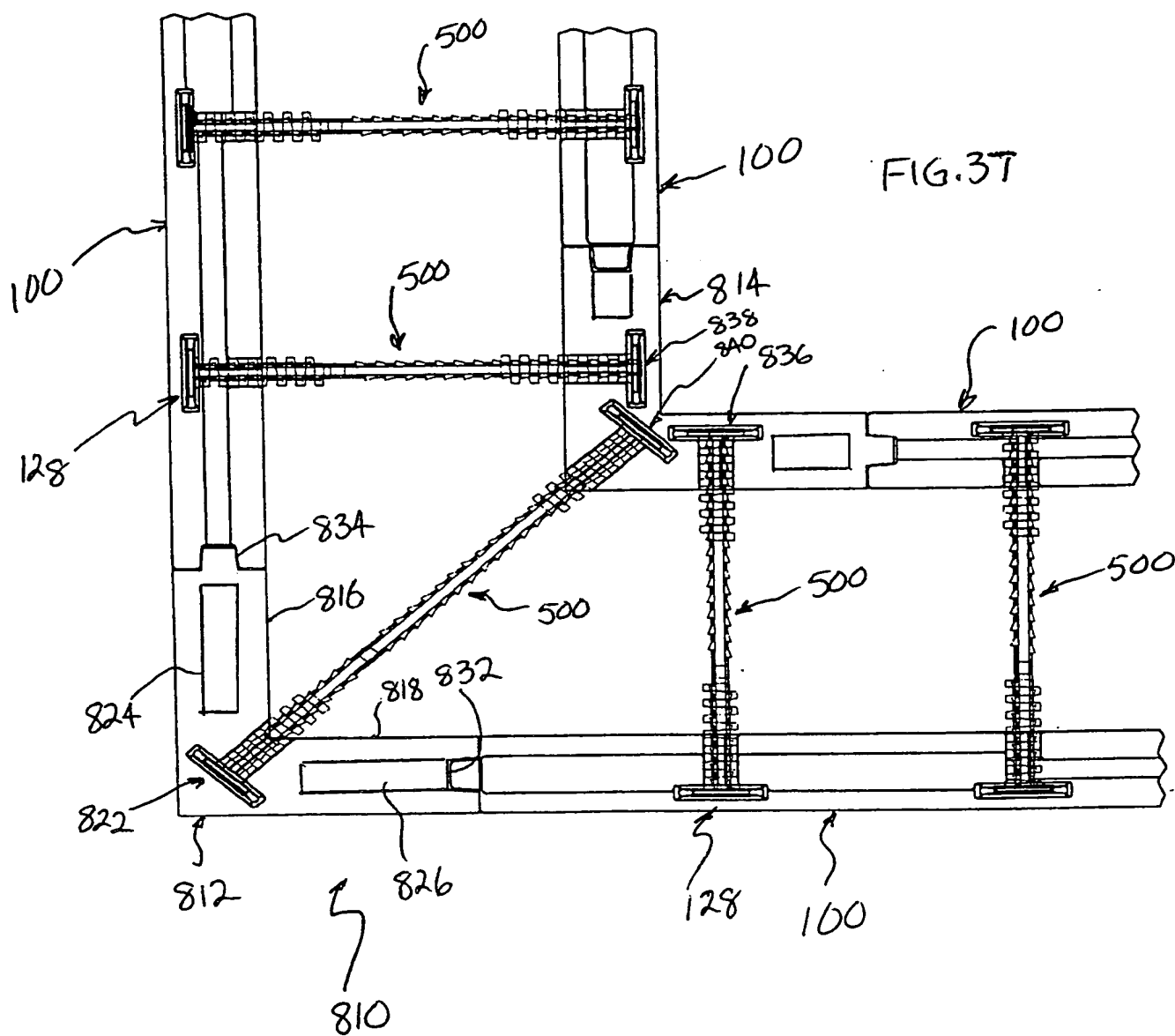


FIG. 34



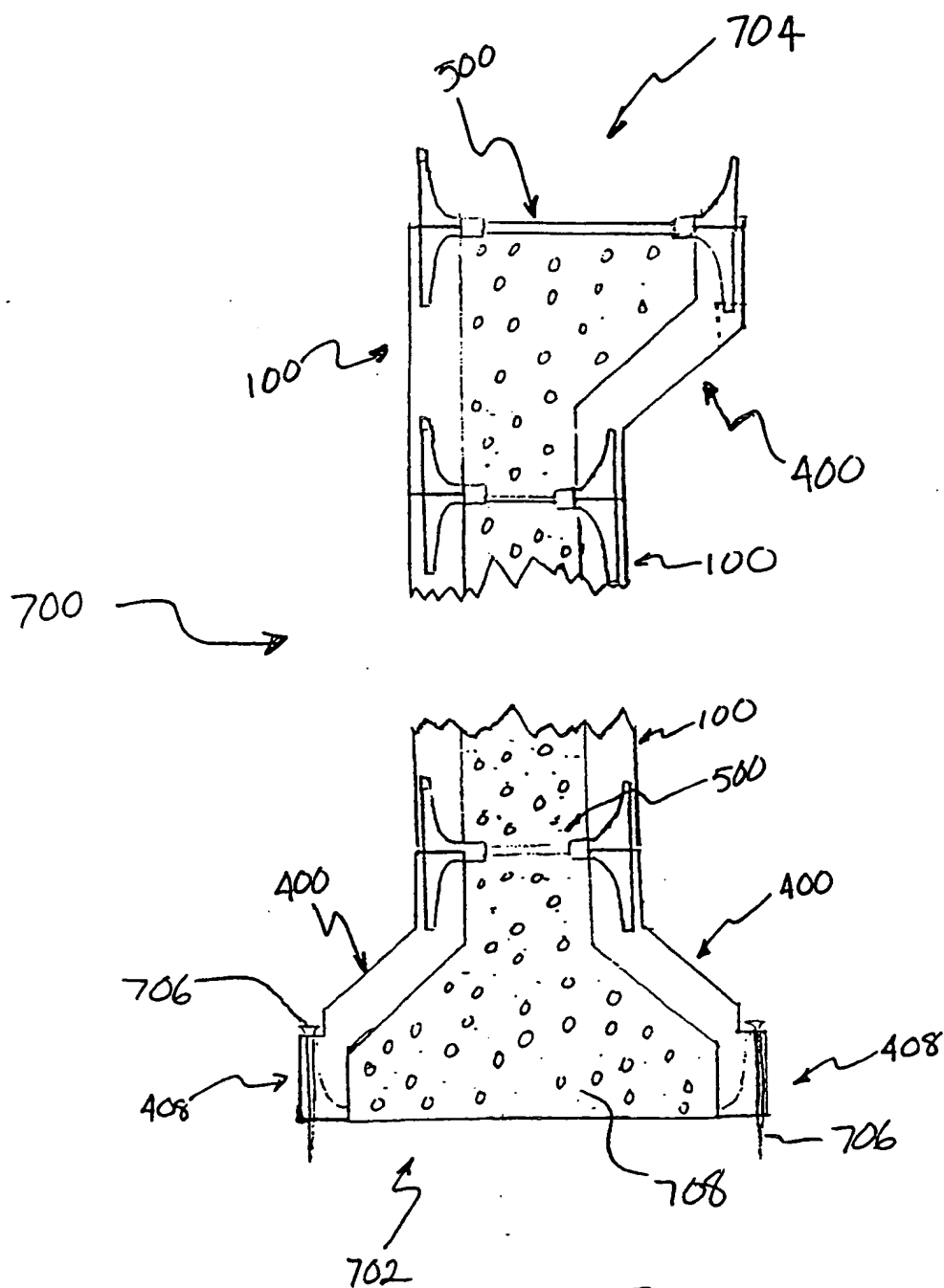


FIG. 37

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/18137

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,884,382 A (HOROBIN) 05 DECEMBER 1989 (05/12/89), SEE ENTIRE DOCUMENT.	1-5
A	US 4,730,422 A (YOUNG) 15 MARCH 1988 (15/03/88), SEE ENTIRE DOCUMENT.	1-31
A	US 4,698,947 A (MCKAY) 13 OCTOBER 1987 (13/10/87), SEE ENTIRE DOCUMENT.	1-31
A	US 5,704,180 A (BOECK) 06 JANUARY 1998 (06/01/98), SEE ENTIRE DOCUMENT.	1-31
A	US 4,091,585 A (RUDICHUK) 30 MAY 1978 (30/05/78), SEE ENTIRE DOCUMENT.	1-31
A	US 3,627,254 A (PRUITT) 14 DECEMBER 1971 (14/12/71), SEE ENTIRE DOCUMENT.	13-24



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/18137

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :EO4G 11/06, 17/06

US CL :52/309.12, 426, 562, 564; 249/34, 40, 45, 191, 213, 216

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 52/309.12, 426, 562, 564, 565, 568; 249/34, 40, 42, 44, 45, 191, 213, 216

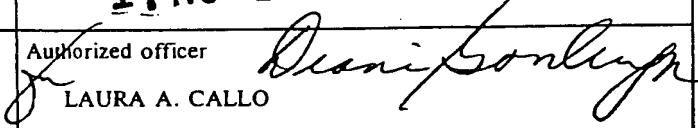
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,604,843 A (OTT ET AL.) 12 AUGUST 1986 (12/08/86), SEE ENTIRE DOCUMENT.	1-9, 13-15, 17, 24, 27-28 ----- 10-12, 25-26, 29-31
X	US 4,888,931 A (MEILLEUR) 26 DECEMBER 1989 (26/12/89), SEE ENTIRE DOCUMENT.	1-2, 27-28
X	US 3,841,600 A (AUBEE, JR.) 15 OCTOBER 1974 (15/10/1974), SEE ENTIRE DOCUMENT.	13-18, 20, 24
Y	US 1,563,581 A (MAY) 01 DECEMBER 1925 (01/12/25), SEE ENTIRE DOCUMENT.	10-12
Y	US 4,177,617 A (DELUCA ET AL.) 11 DECEMBER 1979 (11/12/79), SEE ENTIRE DOCUMENT.	25-26, 29-31

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 17 OCTOBER 2000	Date of mailing of the international search report 17 NOV 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer  LAURA A. CALLO Telephone No. (703) 308-2168